WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

A Scranton Gillette Publication

SEPTEMBER
1957

Unique Reservoir Roof—light weight, economical ..388

The Magnetic Flow Meter and Its Performance 380

The Membrane Filter Procedure—Pros and Cons 385

Advanced Program, F. S. & I. W. A. .....

The giant marine turtle, or "leatherback", is reputed to live for 250 years. This tremendous life span is, in part, attributable to its tough, durable shell—a natural protection against the rigors and constant buffeting of underwater life.

LOCK JOINT REINFORCED CONCRETE SUBAQUEOUS PIPE owes much of its unusual underwater longevity to its "shell"—the dense concrete wall which makes it practically ageless. To assure the strongest possible concrete, periodic compressive tests are taken of each day's run of concrete in every Lock Joint plant. This is only one of the many quality control measures marking every phase of the manufacture of Lock Joint Pipe.

Can you guess how many cubic yards of this high quality concrete were required in the production of the 18,000 ft., 120 inch diameter Lock Joint Reinforced Concrete Subaqueous Pipeline for the intake of Cleveland's water supply system? The answer can be found in the picture above.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

ALL NEW DESIGN!

Simple...Foolproof...Low Cost

1500 WATT HOMELITE GENERATOR

Model 35A115
Homelite Generator
1500 Watts, 115 Volt
60 Cycle AC
90 Pounds

Easy to Carry... ...Easy to Use

1. New Money-Saving Features . . . No DC brushes; just two easy-to-get-at collector ring brushes . . . No commutator or DC windings . . . No intermediate couplings; armature keys directly to shaft. Fewer parts to wear out — longer trouble-free generator service.

2. Constant Voltage . . . less than 4% change from no load to full 1500 watt capacity . . . assures long service life for your electric tools . . . guarantees top performance at all times.

3. Overload Capacity . . . 1500 watt continuous duty with generous overload capacity prevents tool stalling under heavy loads . . . insures uninterrupted service even when starting loads exceed operating loads.

4. Compact and Lightweight . . . one man can easily carry this generator wherever you need electricity to power time-saving electric tools. No need for long, hazardous power-consuming cables.

Whatever tools you want to operate — electric soldering irons, drills, floodlights, grinders, hammers, the new Homelite 35A115 generator can save you money. For a free demonstration or additional information, call your nearest Homelite representative.

SAVE EVEN MORE! New Homelite electronic idle control unit, available as optional accessory, runs engine at idle speed when no current is drawn . . . automatically brings engine to full speed when load is applied.

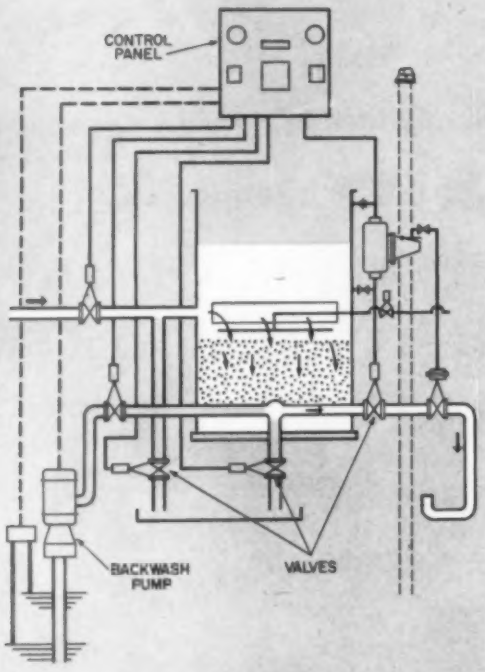
Ask your Homelite representative to show you how this easily-installed accessory reduces engine wear . . . increases service life . . . cuts fuel consumption.

HOMELITE *A DIVISION OF TEXTRON INC*
709 RIVERDALE AVE., PORT CHESTER, N. Y.

Manufacturers of Carryable PUMPS • GENERATORS • BLOWERS • CHAIN SAWS

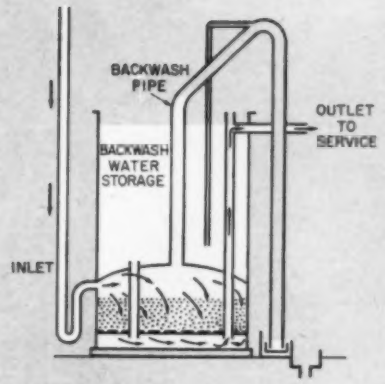
CONVENTIONAL gravity filter and hydraulic controls for automatic operation. Approximate installed cost of a unit that will filter 500,000 gallons per day:

$21,700.00



NEW PERMUTIT VALVELESS Gravity Filter. Completely automatic operation. Approximate installed cost of a 500,000 gpd unit:

$11,900.00



HOW IT WORKS: As dirt collects on the sand, increased head pressure slowly raises the water level in the large backwash pipe. See diagram. When it spills into the downward section of the pipe, it starts a siphon (backwash) flow that draws water down from the Storage area and up through the sand, "floating" dirt off to waste. When backwash water is gone, air enters the small tube and stops the siphon. Flow through the sand reverses and the first filtered water (rinse water) goes to Storage area until full. All flow then runs to Service.

New Valveless Water Filter Saves $$ for Industries, Cities, Electric Companies

● Big water users like city water departments, steam stations, refineries, chemical plants and paper mills can substantially reduce the cost of their water-conditioning equipment and its operation and maintenance . . . by adopting a new automatic Valveless Filter developed by engineers of the Permutit Company (N. Y.).

The simplified design makes ingenious use of the siphon and other hydraulic principles to replace expensive valves, flow controllers, pumps and hydraulic or pneumatic control systems. The design also prevents wasteful, excessive use of water for backwashing or rinsing. Tanks are shipped set-up to reduce installation costs. The absence of moving parts virtually eliminates maintenance costs.

The Valveless Filter produces uniform, high-quality water. It cannot be "forced." Backwashing or rinsing cannot be too little or too late . . . or accidentally run to Service. And the filter cannot develop common troubles like "cracked" or "upset" beds, "channeling" or "mudballs."

Single Valveless Filters or multiple units for any volume requirement are available. Present installations include units for industrial plants treating water for both process and drinking.

Send for free descriptive bulletin. Address: The Permutit Company, Dept. W-9, 330 West 42nd Street, New York 36, N. Y. or The Permutit Company of Canada, Ltd., Toronto 1, Ontario.

PERMUTIT®

rhymes with "compute it"

Water Conditioning

Ion Exchange • Industrial Water Treatment

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

Vol. 104 No. 9

SEPTEMBER, 1957

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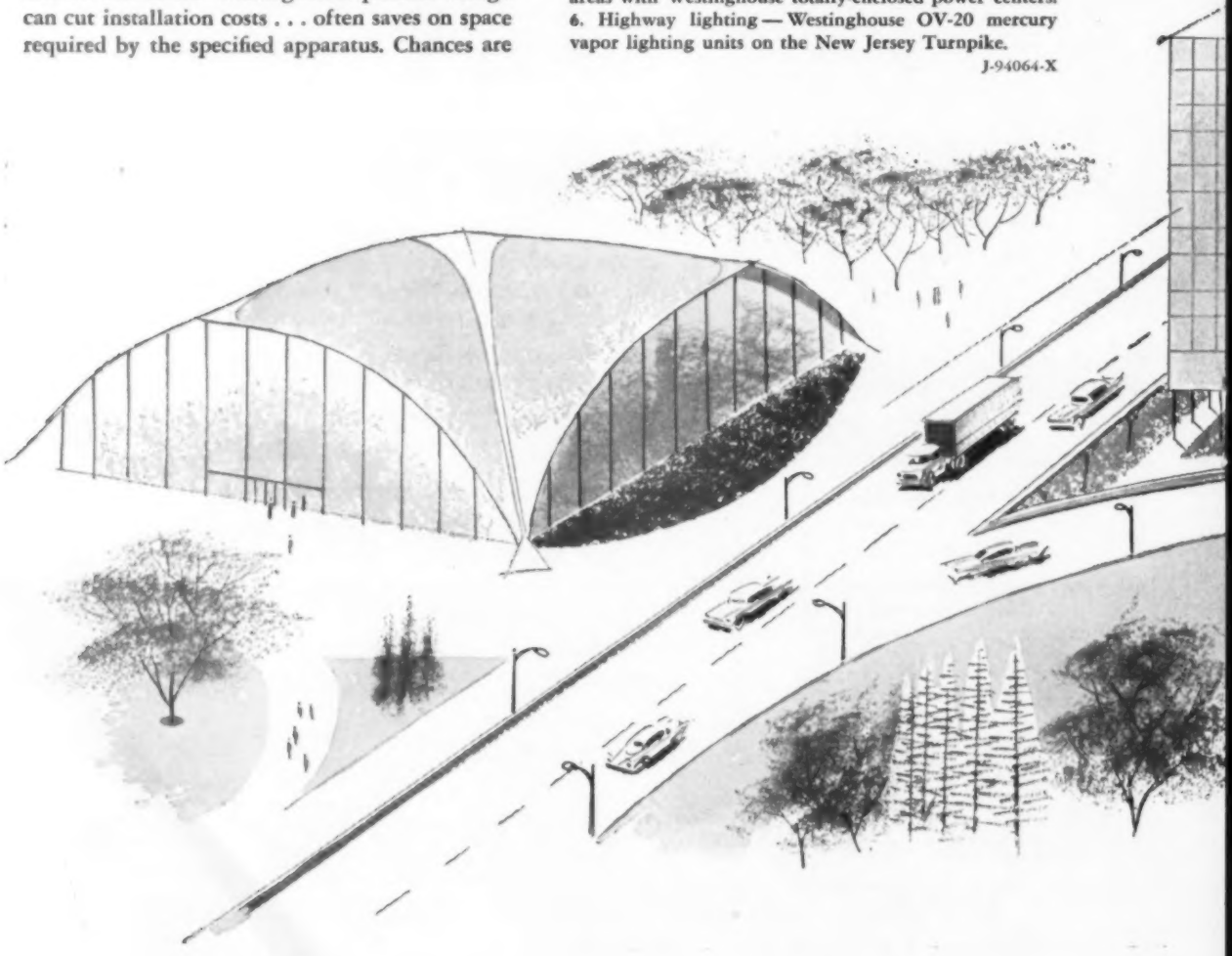
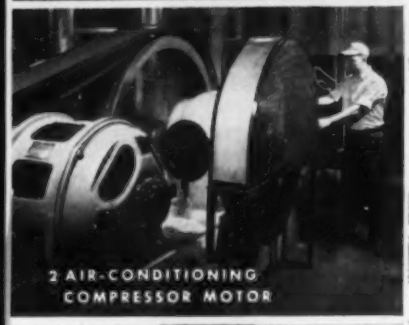
1. More than 100 motor drives are controlled at the City of Houston Water Works by this Westinghouse control center 2. Heavy-duty Westinghouse motor driving air compressor unit. 3. Motor driving freight elevator at the City of Cincinnati Little Miami Sewage Treatment plant. 4. Low-voltage drawout switchgear in municipal building protects branch circuits and equipment with Westinghouse De-ion® circuit breakers. 5. City of Houston Water Works carries high-voltage power close to load areas with Westinghouse totally-enclosed power centers. 6. Highway lighting — Westinghouse OV-20 mercury vapor lighting units on the New Jersey Turnpike.

J-94064-X

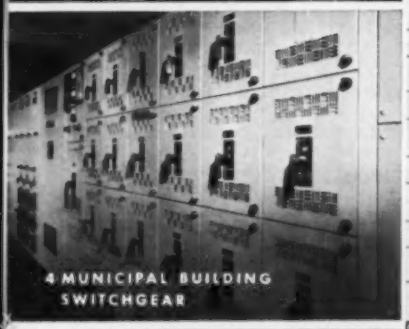


1 WATER SYSTEM CONTROL CENTER



2 AIR-CONDITIONING COMPRESSOR MOTOR

3 MOTOR DRIVE IN SEWAGE PLANT



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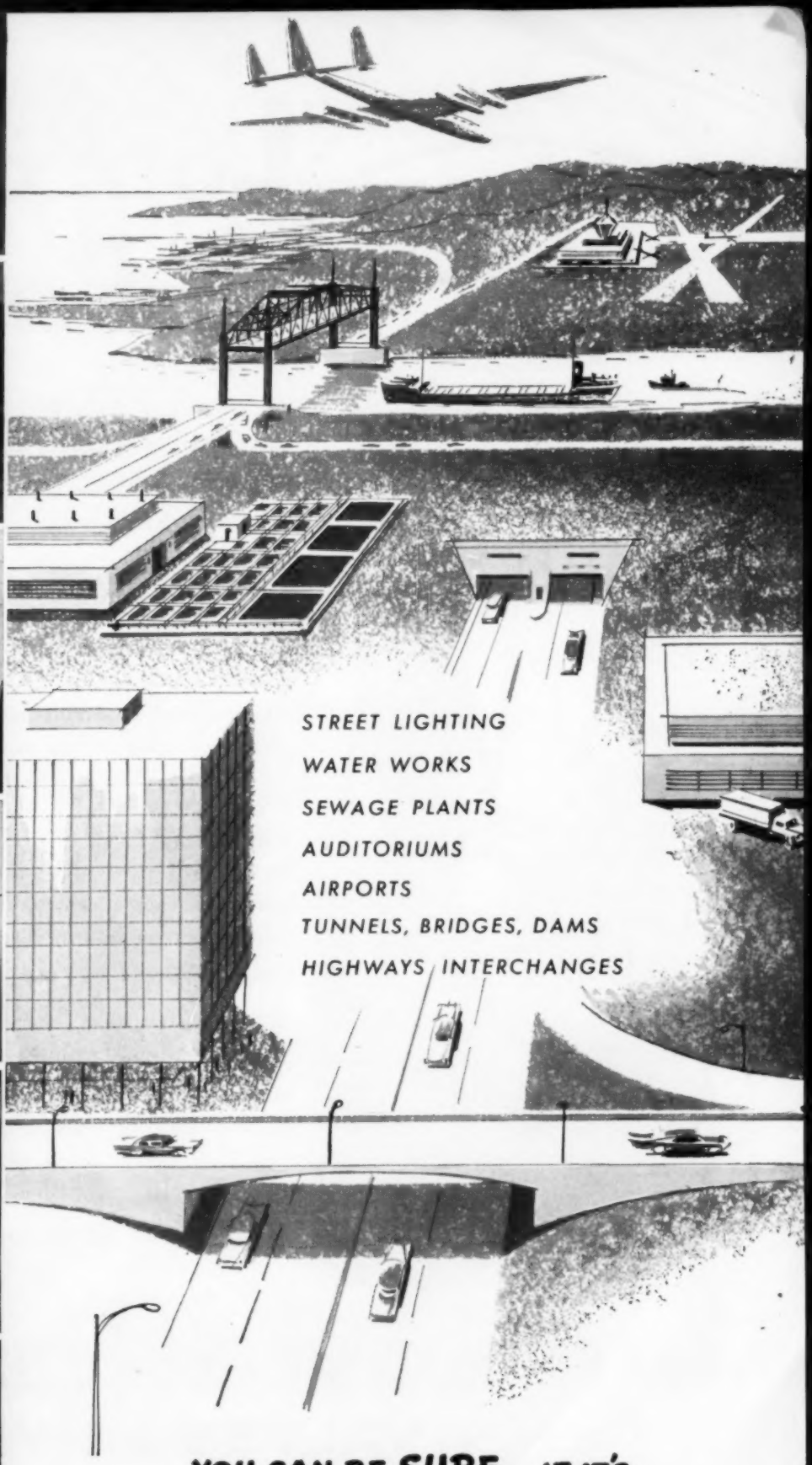
5 POWER CENTER IN WATER WORKS

6 HIGHWAY LIGHTING



STREET LIGHTING
WATER WORKS
SEWAGE PLANTS
AUDITORIUMS
AIRPORTS
TUNNELS, BRIDGES, DAMS
HIGHWAYS / INTERCHANGES

YOU CAN BE SURE... IF IT'S

Westinghouse

LUDLOW

SINCE 1861

LUDLOW and Rensselaer

In nearly a century of specializing in the manufacture of water works valves and fire hydrants, the names Ludlow and Rensselaer have become synonymous with the industry. And today, the research, engineering, manufacturing and servicing resources of these two great companies are consolidated to provide self-evident advantages for the Water Works Industry.

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IC

LUDLOW & Rensselaer

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Since 1861 **THE LUDLOW VALVE MANUFACTURING CO.** *Troy, N. Y.*

VALVES and HYDRANTS

RENSSELAER

SINCE 1885

VALVES: A.W.W.A. valves in sizes from 3 to 48 inch are available in both the Ludlow and the Rensselaer types, and prompt service on spare parts will be continued. A comprehensive choice of valve ends, by-passes, and actuation and indication devices is available for any size valves.

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CHECK VALVES, AIR VALVES, TAPPING SLEEVES AND VALVES, and other devices that insure reliable operation of the system over a long period of time and reduce the original installation costs and the cost of extensions, are available in many types and sizes.

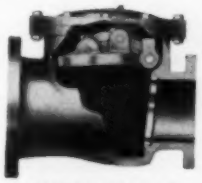
SERVICE: The names Ludlow and Rensselaer on water works equipment will continue to mean quality, reliability and service, as they have for nearly a Century. An enlarged list of sales offices in major cities will expand our local services and insure that the traditions of these two respected names will continue.

BULLETINS AVAILABLE ON ALL PRODUCTS.

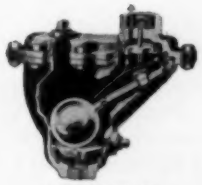
NRS VALVE

GEARED VALVE

HYDRANTS



CHECK VALVE



AIR VALVE

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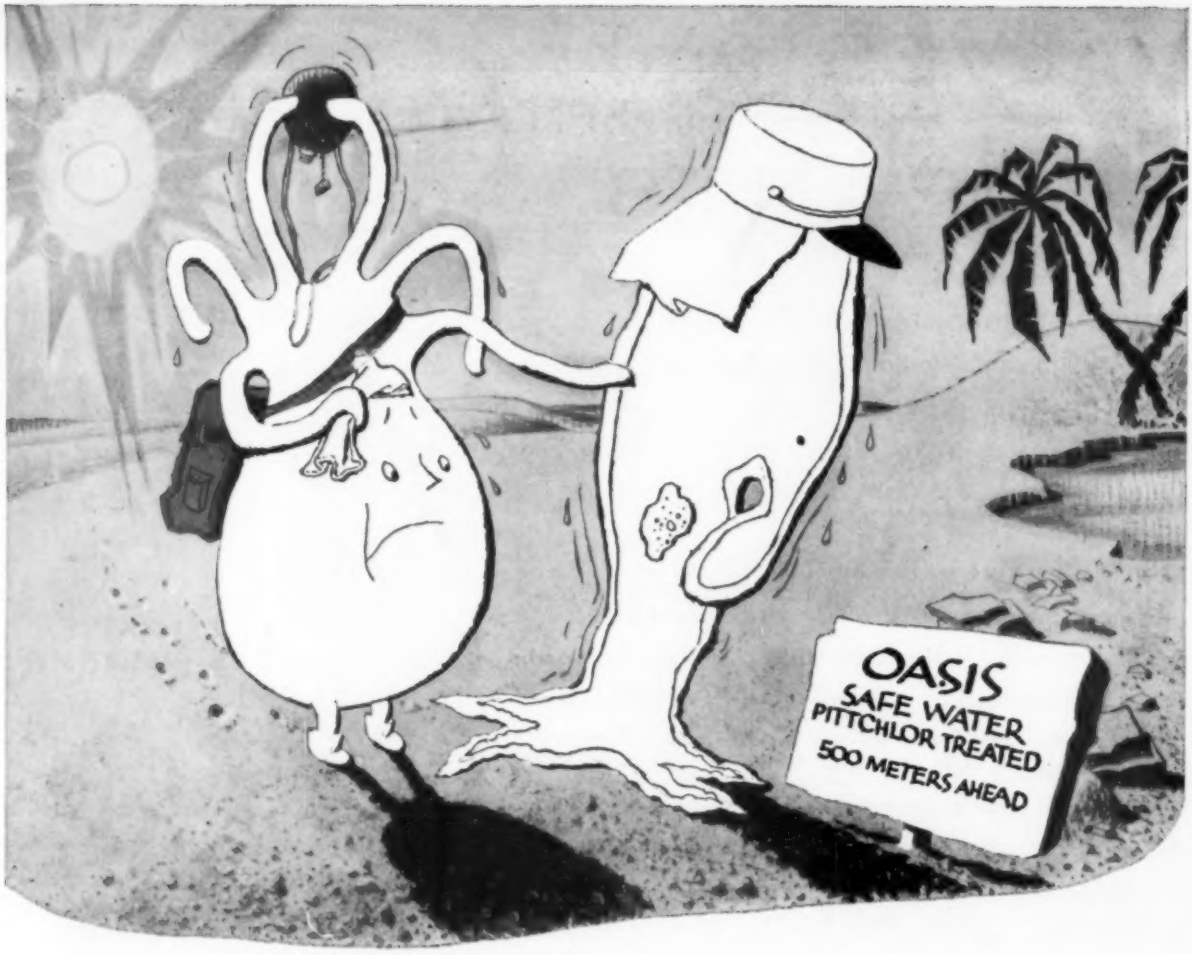
LUDLOW RENSSELAER VALVES & HYDRANTS

Since 1861 **THE LUDLOW VALVE MANUFACTURING CO.** *Troy, N. Y.*



"It's better to take our chances on the desert, Orgie, than to go near water treated with **PITTCHLOR**® !"

That's right, monsieur legionnaire Orgie. In spite of the scorching sun and your dry canteen, you don't *dare* quench your thirst with that "safe" water. It's Pittchlor treated—instant death to you!

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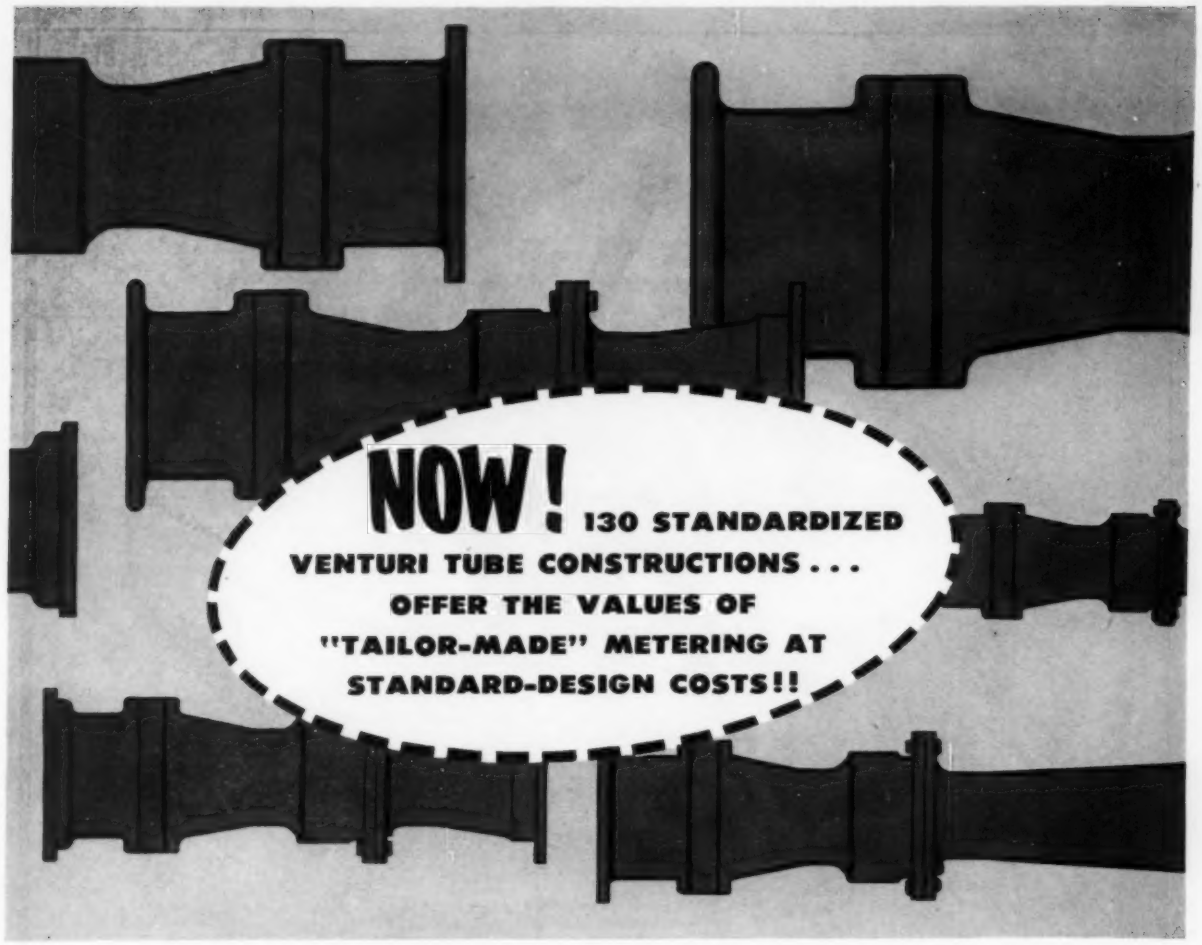

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New Bulletin 110-N1 gives complete data on both Builders short form and Hershel Standard Venturi Tubes. Write to . . .
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DIVISION OF
B-I-F INDUSTRIES
METERS FEEDERS CONTROLS

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Rapidly increasing populations and steadily mounting industrial demands place severe drains on our water systems. Many are outdated.

Fortunately, an average increase of a few pennies a person per day in water rates would supply the money to bring many water systems up to date . . . assure life-giving supply for years to come. Isn't it worth it?

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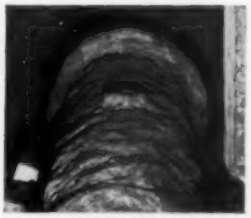
1. **Encourage future water planning.**
2. **Support realistic water rates and water supply bond issues.**
3. **Conserve water where you can.**

Know of *any* substitute for water?



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CAST IRON PIPE SAVES
YOU TAX DOLLARS

This cast iron water main laid in Montreal 141 years ago is still serving. This is typical of many century old cast iron water and gas mains still in use throughout America.

Small wonder that where long life, dependability, and economy are "musts," water officials prefer cast iron pipe . . . No. 1 Tax Saver!

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CAST IRON

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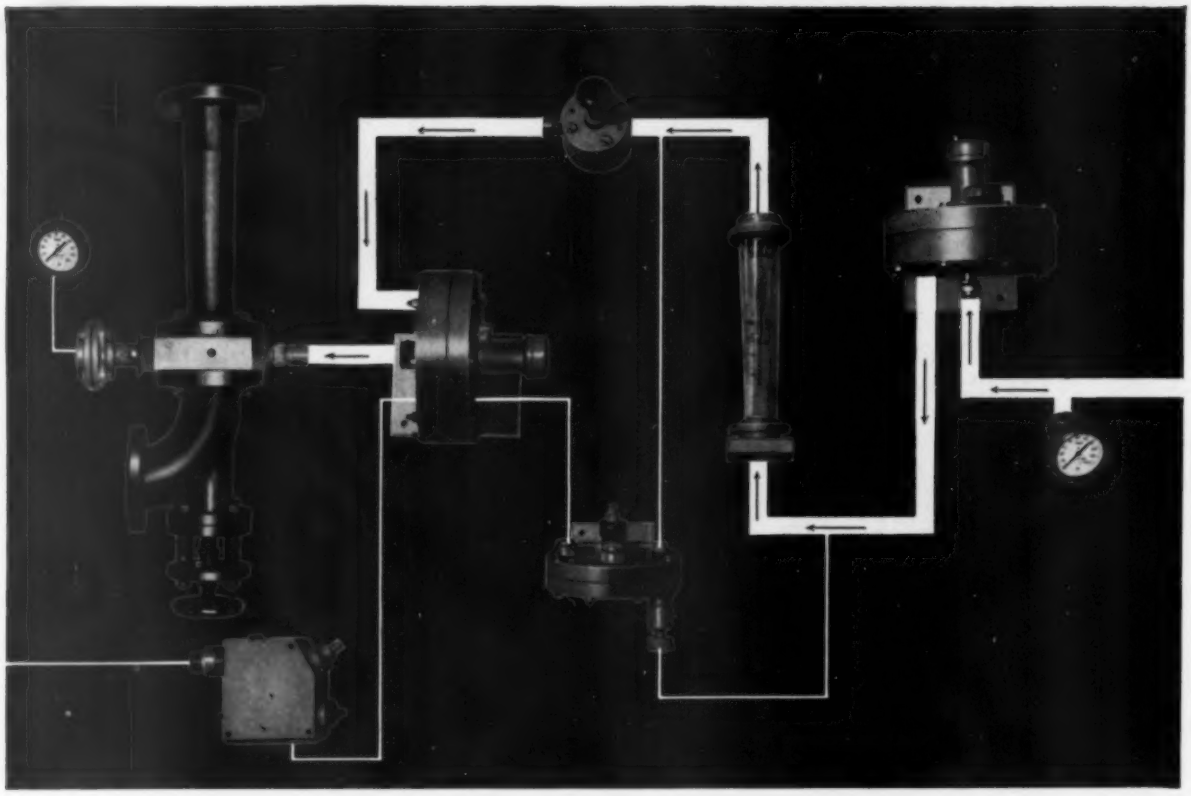
* *Appearing in:* Saturday Evening Post, Newsweek, U. S. News & World Report, Nation's Business.

pipe FOR MODERN WATER WORKS



what to look for in a high capacity chlorinator

Flexibility . . . corrosion resistance . . . safety . . . low maintenance . . . proved performance . . . *whatever* you're looking for, you can be sure of finding it in Fischer & Porter's Model 1052A. The most imitated chlorinator ever introduced, Model 1052A remains unequalled in every major area of chlorinator performance and economy. Engineered from the ground up by chlorine control experts, it's an outstanding example of design from the *user* point of view.

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Recognized as a triumph in materials engineering, the Model 1052A is fabricated of inert materials throughout. Color is impregnated in the fiber glass plastic cabinet . . . never needs painting or coating. The only metals in contact with chlorine are silver and tantalum. The high pressure inlet tube is solid fine silver, and all other tubing is rigid corrosion-resistant plastic.

safe operation protects plant, personnel, public

System design protects against chlorine leakage, positive pressure conditions, excess vacuum, and flooding . . . eliminates need for hazardous water seals.

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proved performance assures results

Every feature of the Model 1052A has proved itself in years of actual use. Every material used in construction has successfully withstood many years of severe chlorine service. But the best proofs of performance are the thousands of satisfied users of Fischer & Porter Chlorinators throughout the country.

Write now for complete details on the Model 1052A given in Catalog 70-15, available on request . . . and with it, we'll be happy to provide a list of installations. Visit any one of these and you'll see why so many users have found everything they were looking for in a Fischer & Porter Chlorinator. Write Fischer & Porter Company, 197 Fischer Road, Hatboro, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane Street, Toronto, Ontario, Canada.

FP

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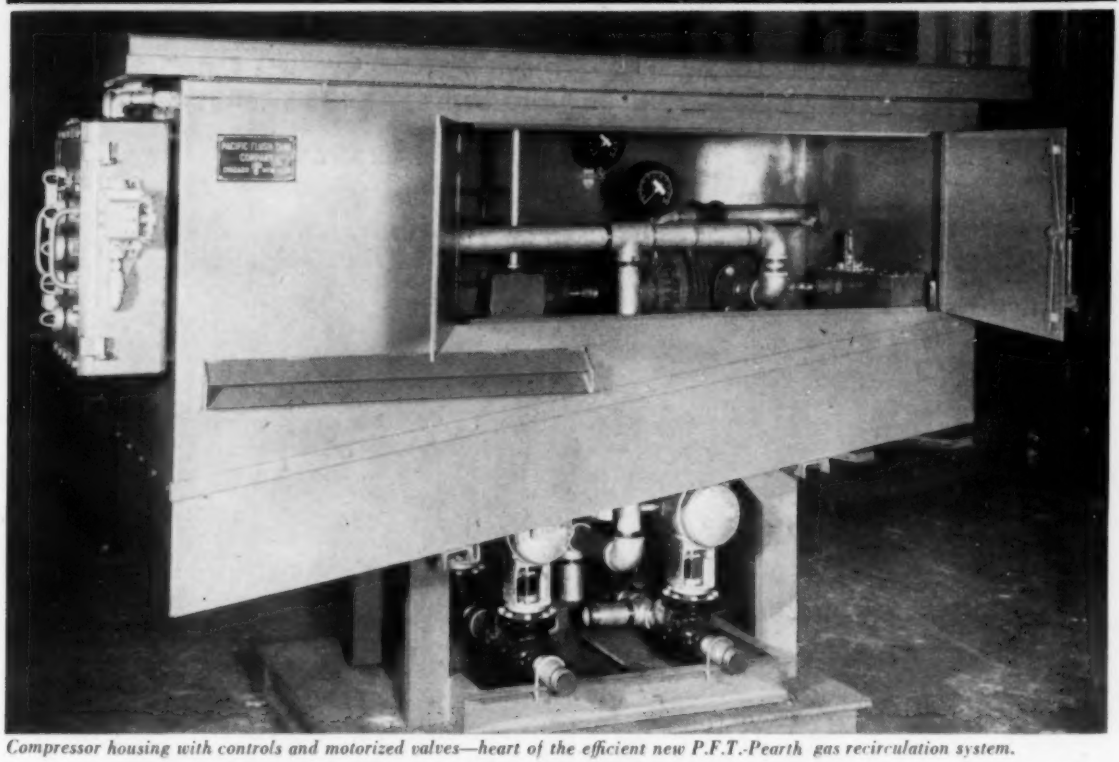
Complete Process Instrumentation

P.F.T. **NEW DEVELOPMENTS IN SEWAGE TREATMENT**



Compressor housing with controls and motorized valves—heart of the efficient new P.F.T.-Pearth gas recirculation system.

Eliminate scum, improve digestion with P.F.T.- Pearth gas recirculation system

Low cost insurance against possible scum difficulties. Future installation of Pearth system, without interruption of digester operation, is simple and economical when optional discharge wells are specified for new P.F.T. Floating Covers.

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VITRIFIED CLAY PIPE IN FOUR FOOT LENGTHS

THE ROOT PROOF AMVIT JOINT

GLASS LINED INSIDE AND OUT

ALL COMBINED TO MAKE AN OUTSTANDING HOUSE-TO-STREET SEWER FOR MODERN HOME REQUIREMENTS

To meet the pressing need for a house connection pipe which could stand up under years of hard service, American Vitrified has developed a new way of glazing vitrified clay pipe. In place of the conventional salt glaze, Amvit Glas-Glaz pipe is lined inside and out with a glass-like ceramic material. This pipe with glass lining is smoother, stronger, more acid resistant and together with the Amvit Joint, root proof, tighter and timeless.

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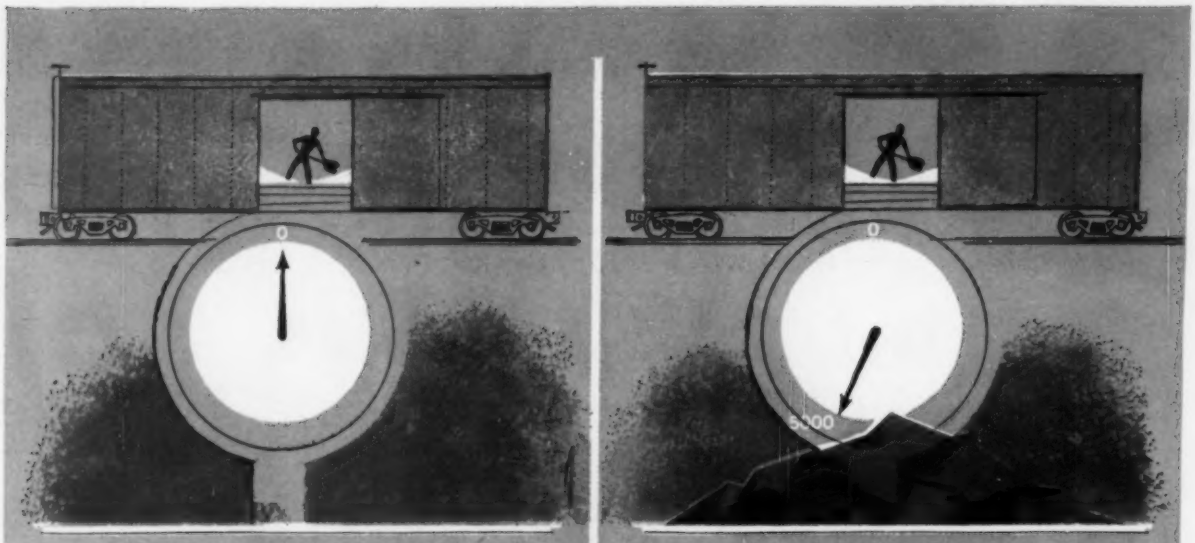
American Vitrified Products Company
CLEVELAND, OHIO

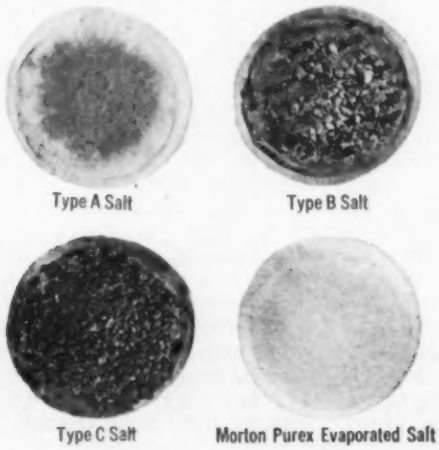


A carload (50 Tons)—of Morton Purex Salt contains virtually no wasteful insoluble matter or sludge—shale and sulphates.

A carload (50 Tons)—of salt can often contain as much as 5000 lbs. of sludge which you pay as part of purchase *and* freight costs.

Stop paying for wasteful sludge —switch to Purex Salt

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Type A Salt | Type B Salt | Type C Salt | Morton Purex Evaporated Salt

Tests for insolubles taken from random samples show you that Morton Purex is the only one that contains no wasteful sludge or insolubles.

For more information about Morton Purex Salt, and for free, expert help on any water-softening problem, write:

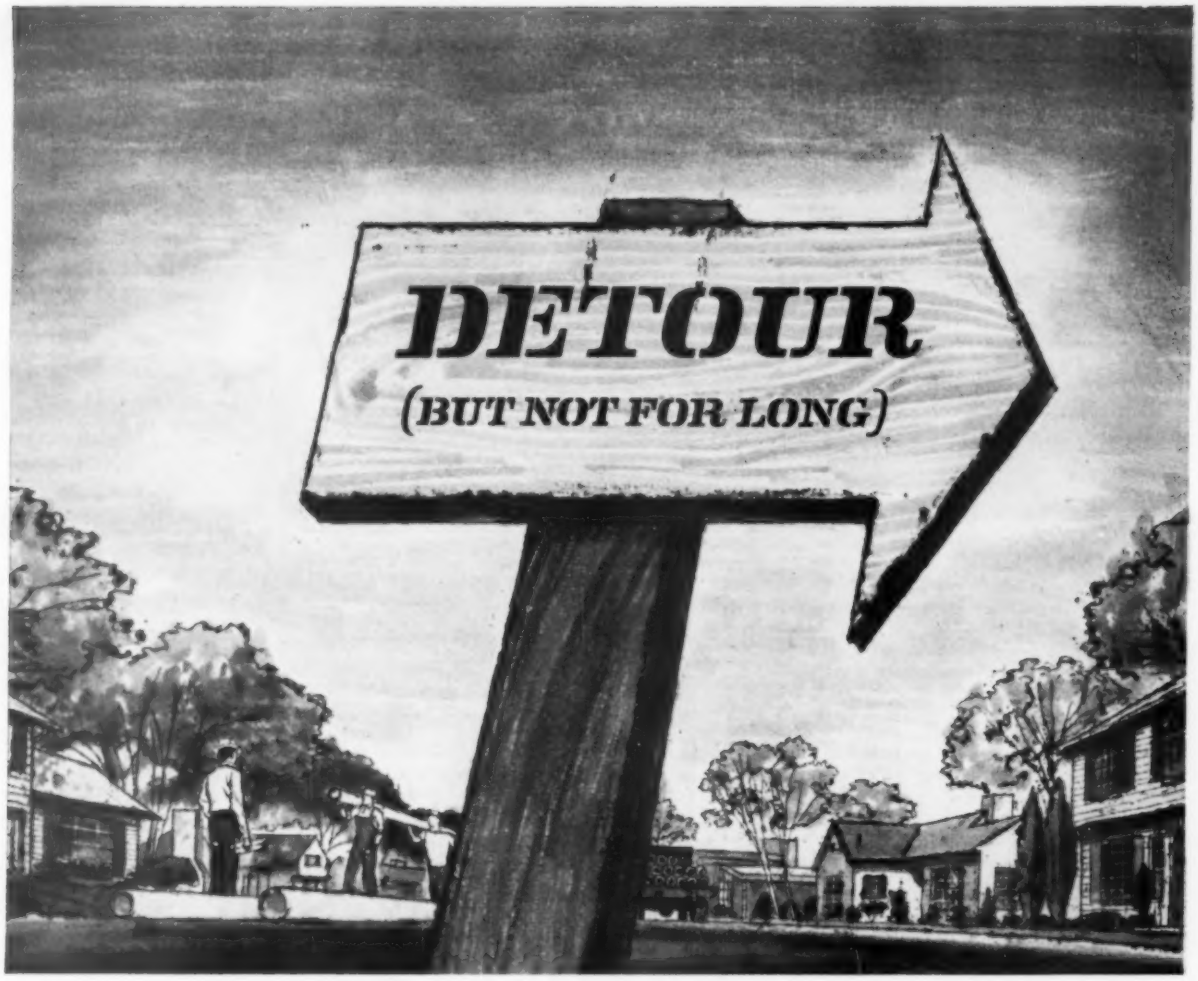
When you buy Morton Purex Salt, you get high purity evaporated salt that is made in a controlled-particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for useless, troublesome insoluble matter.

With Morton Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex will leave no accumulation of material in either brine or water softener tanks. It can be used in wet-storage systems, and in the Morton Model-E Brinemaker.

MORTON SALT COMPANY

INDUSTRIAL DIVISION

Dept. 0000, 120 So. LaSalle Street, Chicago 3, Illinois



Transite Sewer Pipe installs fast . . . to last!

. . . keeps installed costs lower . . . licks infiltration, root clogging

Transite's Ring-Tite Coupling prevents two major sewer line problems. It locks out roots . . . seals out ground water!

Its Ring-Tite Coupling is quickly assembled, provides a tight, long-lasting seal!

IN A SEWER PIPE INSTALLATION, you want a good "tight" system . . . and you want it completed fast! You get both of these advantages as well as long life and operating efficiency with Transite® asbestos-cement Pipe and the Ring-Tite® Coupling.

Why? Because lightweight Transite reduces handling costs, speeds work above and below ground. Quickly-assembled with the Ring-Tite Coupling, Transite Pipe ends are joined easily . . . *surely!* And to give you a tight long-lasting joint, rubber sealing rings in the Ring-Tite Coupling are tightly compressed between sleeve and pipe to lock out roots and overcome infiltration problems.

Another advantage of Transite Sewer Pipe is its smooth interior; its coefficient of flow is n=0.010. This results in substantial savings—lets you use smaller diameter Transite Pipe, or permits laying to flatter grades.

Let us send you booklet TR-165A. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

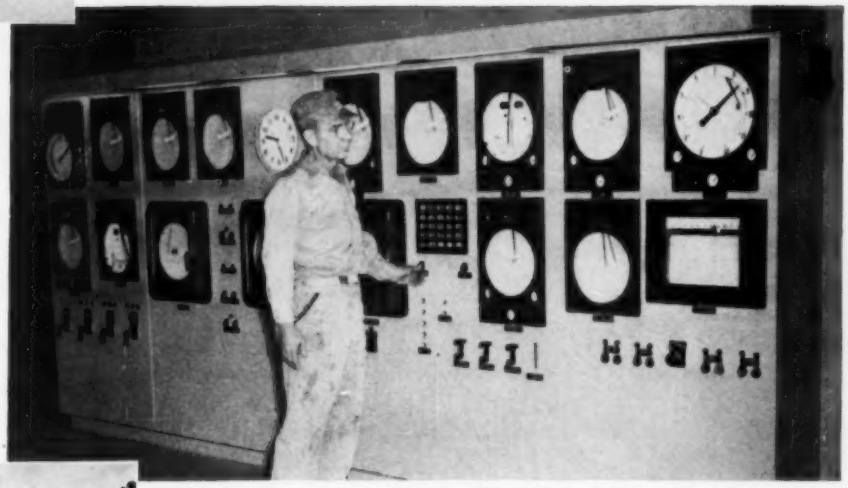
Johns-Manville

TRANSITE SEWER PIPE WITH THE RING-TITE COUPLING

From each *FiltermatiC* console, the operator can choose between *local, automatic,* and *clearwell level-to-effluent cascade control* of filtering rates. He can also start washing by turning a single switch, and control wash rates.

Fort Hood Water Treatment Plant

saves time and chemicals with FiltermatiC Control System*



Central control panel provides all data and alarms needed to supervise the Fort Hood Water Treatment Plant. The operator monitors plant operation from this central location without having to inspect individual treating facilities.

Level-to-flow cascade control system maintains a one-inch drop over weirs between the two settling basins so that fine floc will not break up when it falls into the settled water channel.

ALL key variables at the Fort Hood Water Treatment Plant, near Belton, Texas, are regulated by a Honeywell *FiltermatiC* control system. This automatic, centralized system simplifies plant supervision, saves man-hours. The accuracy of the system in proportioning chlorine, alum and lime from actual flow rates keeps chemical costs down, safeguards plant efficiency.

The plant was designed by Freese, Nichols & Turner, consulting engineers, and built by Merritt, Chapman and Scott, general contractors. Treating facilities consist of raw-water pumping, chlorination, flocculation and sedimentation, rapid-sand filtration and high-lift pumping—all controlled by the *FiltermatiC* system.

Your nearby Honeywell field engineer can help you gain the many advantages of automatic control in your own plant. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* Wayne and Windrim Avenues, Philadelphia 44, Pa.

*Trademark of Minneapolis-Honeywell Regulator Co.

Honeywell

First in Controls

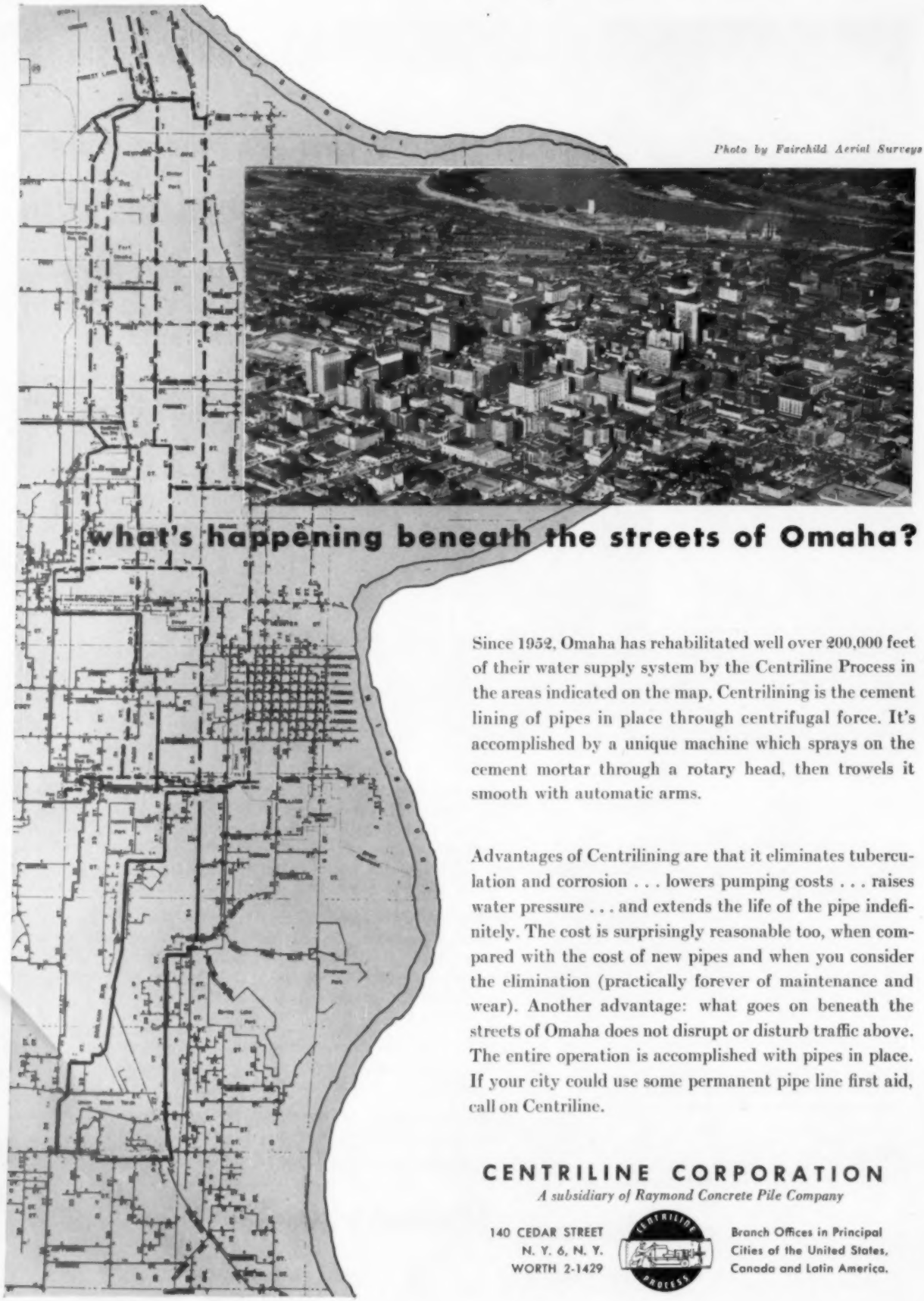


Photo by Fairchild Aerial Surveys

what's happening beneath the streets of Omaha?

Since 1952, Omaha has rehabilitated well over 200,000 feet of their water supply system by the Centriline Process in the areas indicated on the map. Centrilining is the cement lining of pipes in place through centrifugal force. It's accomplished by a unique machine which sprays on the cement mortar through a rotary head, then trowels it smooth with automatic arms.

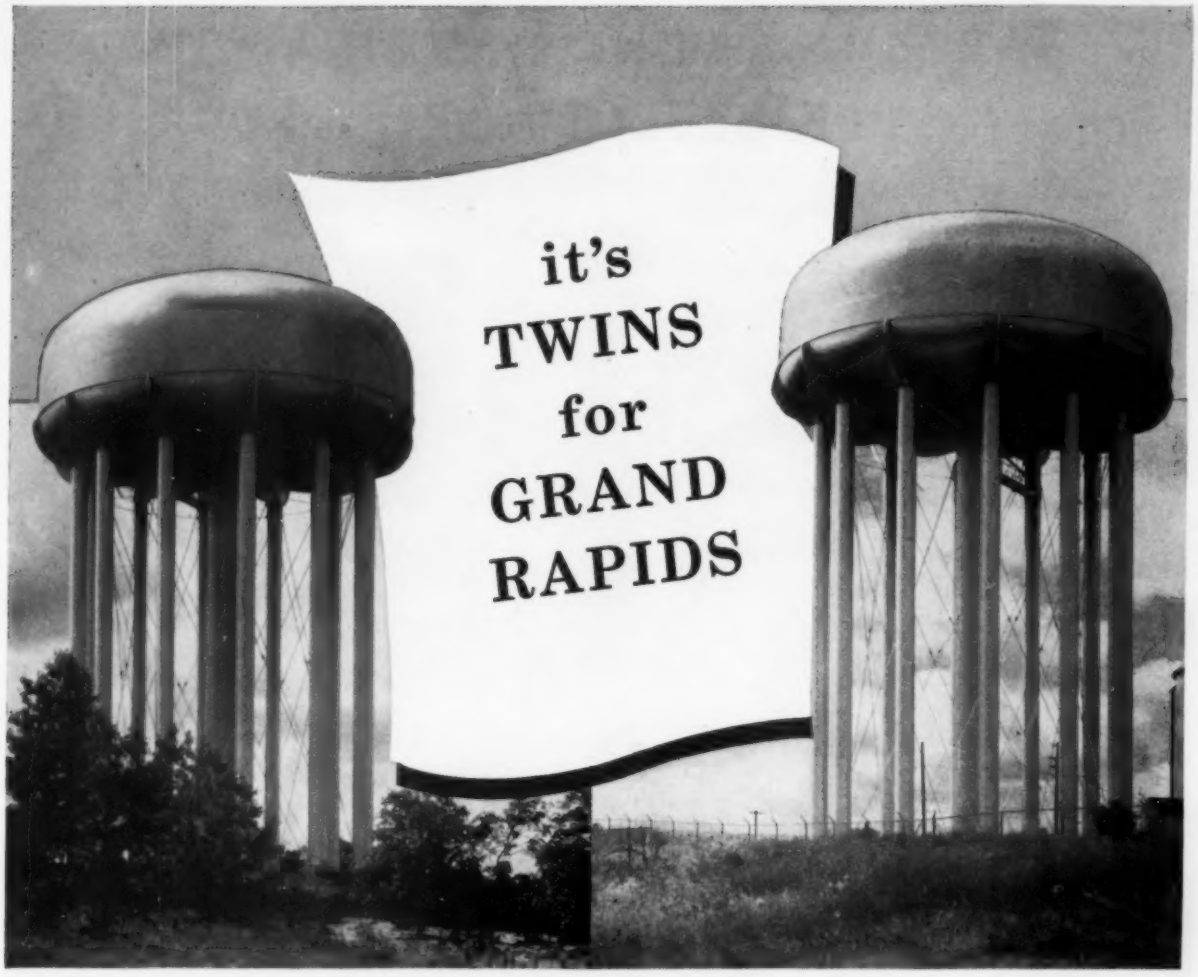
Advantages of Centrilining are that it eliminates tuberculation and corrosion . . . lowers pumping costs . . . raises water pressure . . . and extends the life of the pipe indefinitely. The cost is surprisingly reasonable too, when compared with the cost of new pipes and when you consider the elimination (practically forever of maintenance and wear). Another advantage: what goes on beneath the streets of Omaha does not disrupt or disturb traffic above. The entire operation is accomplished with pipes in place. If your city could use some permanent pipe line first aid, call on Centriline.

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Company

140 CEDAR STREET
N. Y. 6, N. Y.
WORTH 2-1429

Branch Offices in Principal Cities of the United States, Canada and Latin America.



Two 1,250,000-gal. Horton Radial-Cone Tanks provide modern water storage

It's identical twins for the city fathers of growing Grand Rapids, Michigan!

These two Horton® radial-cone bottom elevated tanks provide 2,500,000 gallons additional water storage capacity and provide dependable gravity pressure to meet peak load periods in suburban Grand Rapids. The two tanks stand 95 feet to the bottom and have a 30 ft. range in head.

By reducing the load on a community's overworked pumping, treating and transmission facilities, Horton elevated tanks improve distribution pressures, provide emergency reserves, improve insurance ratings and reduce pumping costs.

Horton radial-cone bottom tanks are built in capacities to 3,000,000 gallons. Combining sound engineering with practical design they can take the "pain" out of *growing* for your community. Write our nearest office for further information.

Two identical 1,250,000-gallon Horton radial-cone bottom elevated tanks built for Grand Rapids, Michigan.

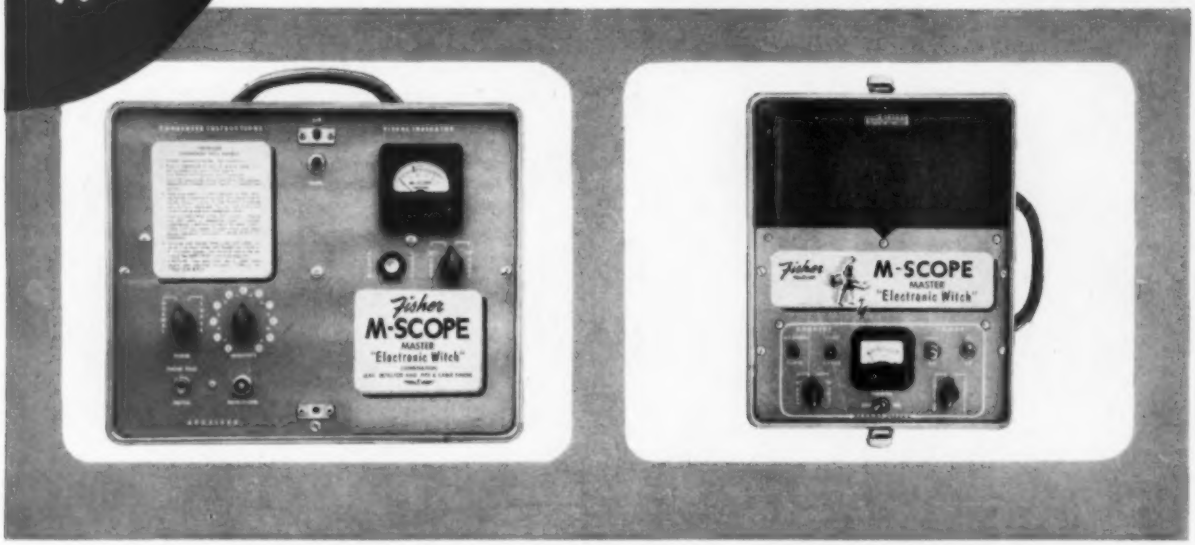
CBI

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

New!

TIME-$AVING COMBINATION LEAK DETECTOR-PIPE LOCATOR



THE M-SCOPE MASTER Electronic Witch Combination

You're looking at the much-talked-about **NEW** M-Scope . . . the only dual-purpose that detects leaks **and** locates pipe. Its rugged, highly efficient electronic circuit, plus ease of use and portability, make this instrument one of the most welcome contributions to the water works industry.

Quick Facts

LOCATING A LEAK AT THE VALVE

FINDING A LEAK UNDER PAVEMENT

ONE MAN OPERATION

LOCATING A SERVICE

For greatest convenience and reliability, the M-Scope MASTER is equipped with a **built-in battery tester** for instant checking of battery condition in the field or elsewhere.

WRITE TODAY FOR SPECIFICATIONS AND PRICE!

PIPE LINE EQUIPMENT

JOSEPH G. POLLARD CO., INC.

PIPE LINE EQUIPMENT

PIPE LINE EQUIPMENT

Place your next order with POLLARD

If it's from POLLARD . . . It's the Best in Pipe Line Equipment

NEW HYDE PARK • NEW YORK

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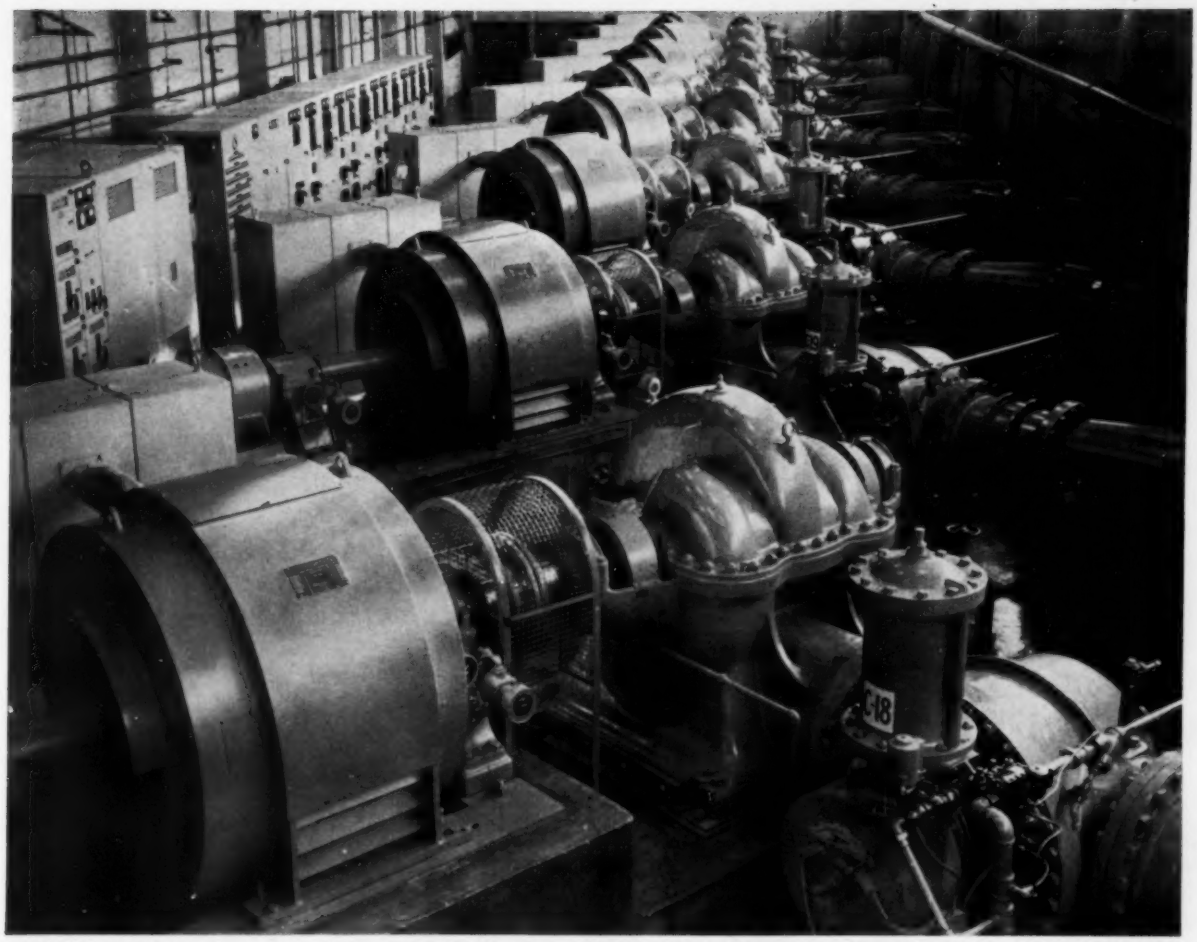


Eight 24" SMS-Rotovalves are used for pump check service at the Secondary Pumping Station of the U. S. Air Force's Arnold Engineering Development Center in Tullahoma, Tenn.* Installed on 25,000 GPM pumping units, each hydraulically-operated Rotovalve has independent timing control for opening and closing, and a by-pass fast closure device for shut down in the event of power failure. Four more 24" Rotovalves perform similar service at the Primary Pumping Station.

CLOSE CONTROL OF TIMING MAKES SMS-ROTOVALVES CHOICE AT TULLAHOMA

When laying out the cooling water facilities at Tullahoma, Robert and Company Associates of Atlanta, Consulting Engineers under contract with the Tullahoma District, Corps of Engineers, U. S. Army, selected SMS-Rotovalves for pump check service. Close, positive control of valve opening and closing time that minimizes water hammer as pumps are cut in and out of the system made Rotovalves the first choice. Their rugged design and record for low maintenance cost were also important for this severe service.

SMS-Rotovalves' full-line opening offers no more resistance than straight pipe of the same diameter, means less head loss and lower pumping costs. Maximum initial shut-off, with retarded area reduction at the closing end of the stroke, controls water hammer. Opening and closing can be as fast as one second, or as slow as needed. Closure is drop tight, and monel-to-monel seats are self-purging.

You can obtain full information on SMS-Rotovalves, Ball Valves or Butterfly Valves by contacting our nearest representative. Or, write to S. Morgan Smith Co., York, Penna.

*Under construction by the Corps of Engineers, U. S. Army.

S. MORGAN SMITH

HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

5

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

simplicity

"IT'S SHORE WONDERFUL . . . EVEN
COUSIN FOOLEY KIN PUT IT TOGETHER."

U.S. cast iron PIPE FOR WATER, SEWERAGE AND

itself

Our new "Tyton Joint" pipe assembles so easily even an inexperienced crew can master the technique quickly.

Only one accessory needed...a specially designed rubber gasket which seats in the bell. The entering pipe slides into place easily, compressing the gasket... making a tight, permanent seal.

No bell holes needed. What's more, "Tyton Joint" doesn't mind wet feet. You can lay it in the rain if need be!

Like to know more about this revolutionary, new pipe joint that saves time and trouble in the trench...and money on your contract?

Write or call today for the facts on "Tyton."

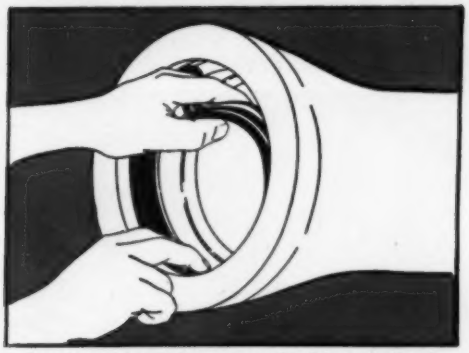
U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE

INDUSTRIAL SERVICE CAST IRON

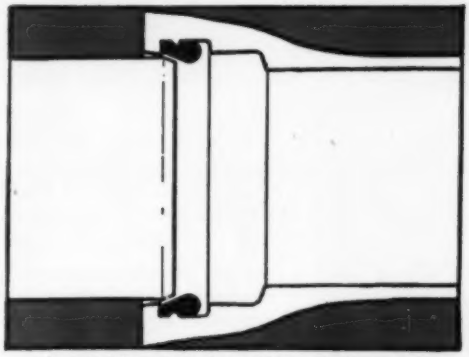
U. S. TYTON JOINT

ONLY FOUR SIMPLE ACTIONS

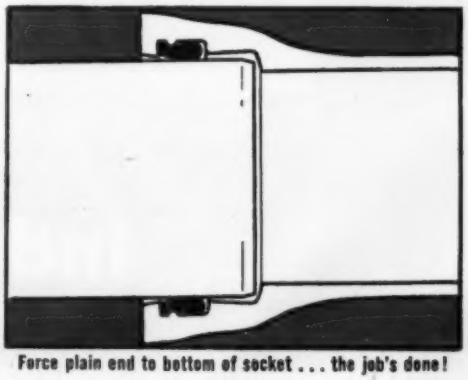


Insert gasket with groove over bead in gasket seat

Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!

Palatable Water at LOW COST

A satisfactory palatable water is never achieved by halfway dosages of Aqua Nuchar Activated Carbon. To be certain that all odors are adsorbed, the correct amount of Aqua Nuchar *must* be applied. In the majority of plants where Aqua Nuchar is used, it has been found that 20 pounds or more are needed to give proper odor and taste control to 1,000,000 gallons of water. This, certainly, is inexpensive treatment.

Many plants are adopting the practice of continuous application of Aqua Nuchar, thus keeping the plant seeded. This gives assurance against development of odors within the plant due to decomposing sludge. Also, periods of sudden odor surges can be controlled with lower dosages than would be necessary if the plant were not already seeded with Aqua Nuchar.

To solve your water odor problem, call or write our nearest office. A member of our technical staff will work at your plant to help make the water palatable, at no cost or obligation on your part.

GOOD CARBON · GOOD WATER · GOOD WILL

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230 Park Ave., New York 17, N.Y.
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Broad & Chestnut Sts., Phila. 7, Pa.

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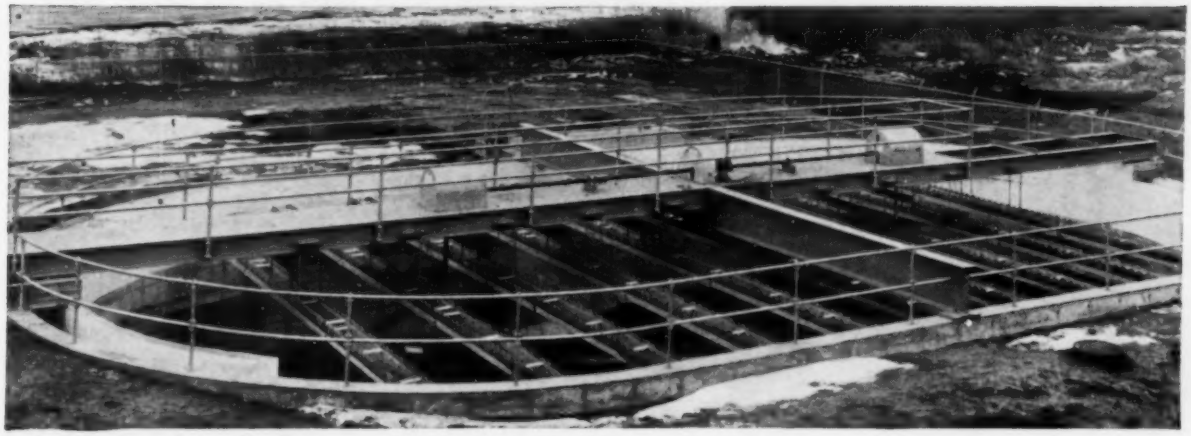
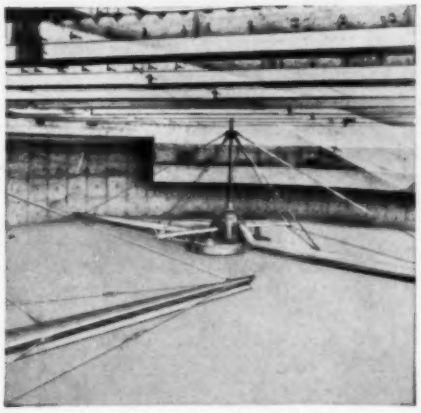
Cleveland 20, Ohio

REX® UNITUBE TOW-BRO®

chosen to solve a difficult sludge removal problem



Construction view of unique settling tank at Wilson & Co. waste treatment plant, Albert Lea, Minn. This new high-rate anaerobic digestion process for treating packing plant waste was developed jointly by W. J. Fullen of Austin, Minn., and Professor G. J. Schroepfer, University of Minnesota. Plant was designed by A. J. Steffen, Wilson & Co. Sanitary Engineer, and the Consulting Engineering firm of Toltz, King, Duvall, Anderson and Associates, Inc.



Close-up of Unitube headers.

THE PROBLEM: Wilson & Co. at Albert Lea, Minnesota, needed an efficient treatment plant for handling packing plant waste. Pilot plant work and investigation by consulting engineers and Mr. Steffen indicated the need for a sludge removal device to meet these rigid requirements:

1. Complete removal of sludge from tank bottom for each revolution of sludge removal device (8½ min.)
2. Ability to handle tremendous sludge volumes (up to 300% of raw flow)
3. High solids concentration
4. Flexibility
5. Proven hydraulic design
6. Provisions for single- or two-stage operation

CHAIN Belt's broad experience in the hydraulics of settling basins and in the application of Tow-Bro was called upon in working out a solution to the problem.

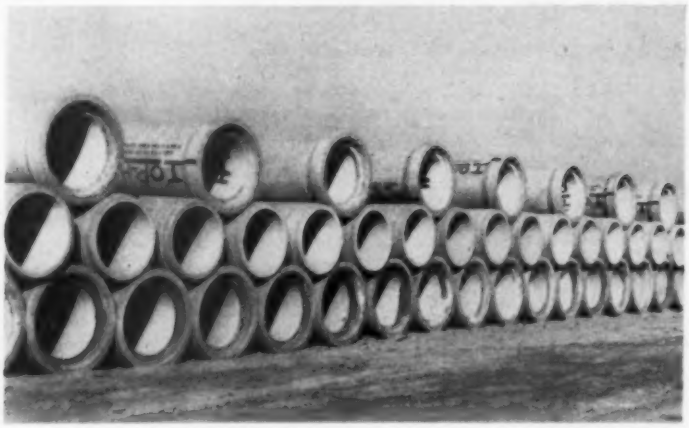
THE SOLUTION: The Rex Unitube Tow-Bro mechanisms with interchangeable headers installed in a unique dumbbell-shaped tank. A novel inlet and effluent system provides for either single- or two-stage operation in the single tank.

For any sludge removal problem, Unitube Tow-Bro design assures a clearer effluent... greatest solids concentration... less reaeration...greater operating flexibility...low operating and construction costs. For complete information, write for your copy of Bulletin 315-81. CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

CHAIN BELT COMPANY

Milwaukee 1, Wisconsin

A NEW CONCRETE PRESSURE PIPE *of unequalled* ECONOMY



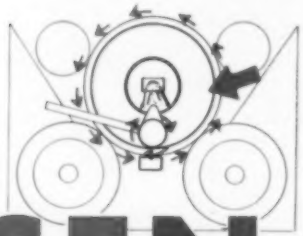
Recently, a large chemical company in Louisiana selected Cen-Vi-Ro Concrete Pressure Pipe to move fresh water into its new plant. Cen-Vi-Ro easily exceeded the hydrostatic and other test requirements, insuring the owners a permanent and maintenance-free installation. The close tolerances of Cen-Vi-Ro's precision-formed joints . . . measured in thousandths . . . combined with special O-ring type Rubber Gasket Seal assure perfect leak-proof connections under even the most adverse field conditions.

Lower first cost plus longer lengths result in a more economical installation . . . *every time!*

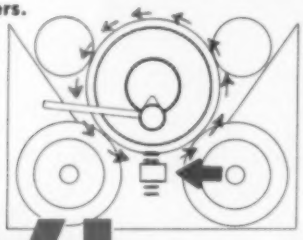
Write for complete Cen-Vi-Ro information . . .

THE NAME, ITSELF, *means* THE WORLD'S FINEST PIPE!

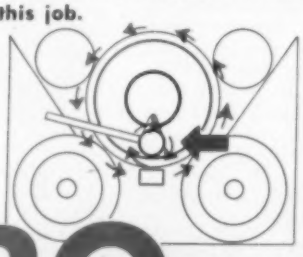
The Cen-Vi-Ro process is a combination of simultaneously *consolidating* and *pressurizing* a dry, zero-slump mix . . . to produce an extremely dense and impervious concrete with even distribution of the coarse aggregate and cement mortar.



CEN- comes from CENtrifugally spinning the very dry "earth-moist" mixture, fed into the form by belt conveyor in uniform layers.



VI- comes from VIbration of the spinning form during the charging period. Specially designed vibrator-tampers on the underside of the form do this job.



RO- comes from ROlling the mixture under great pressure applied by a specially designed steel roller.

Vulcan Materials Company

Southern CEN-VI-RO PIPE CORPORATION

P. O. DRAWER 155, BIRMINGHAM, ALABAMA

A Division of Vulcan Materials Company

NOW! You can increase system reliability and reduce costs with *the most advanced* supervisory control system offered for centralizing and remote-controlling the many operations in modern water works and sewage treatment plants.

Builders Synchro-Scan® systems stress design simplicity, dependability, and safety. All components are "plug-in" type . . . including *transistorized* tone units for signal transmission . . . providing the ultimate in ease and economy of installation, operation, and system expansion.

Request Bulletin 240-P2A today . . . and benefit from Builders specialized knowledge of water and sewage works metering and control problems.

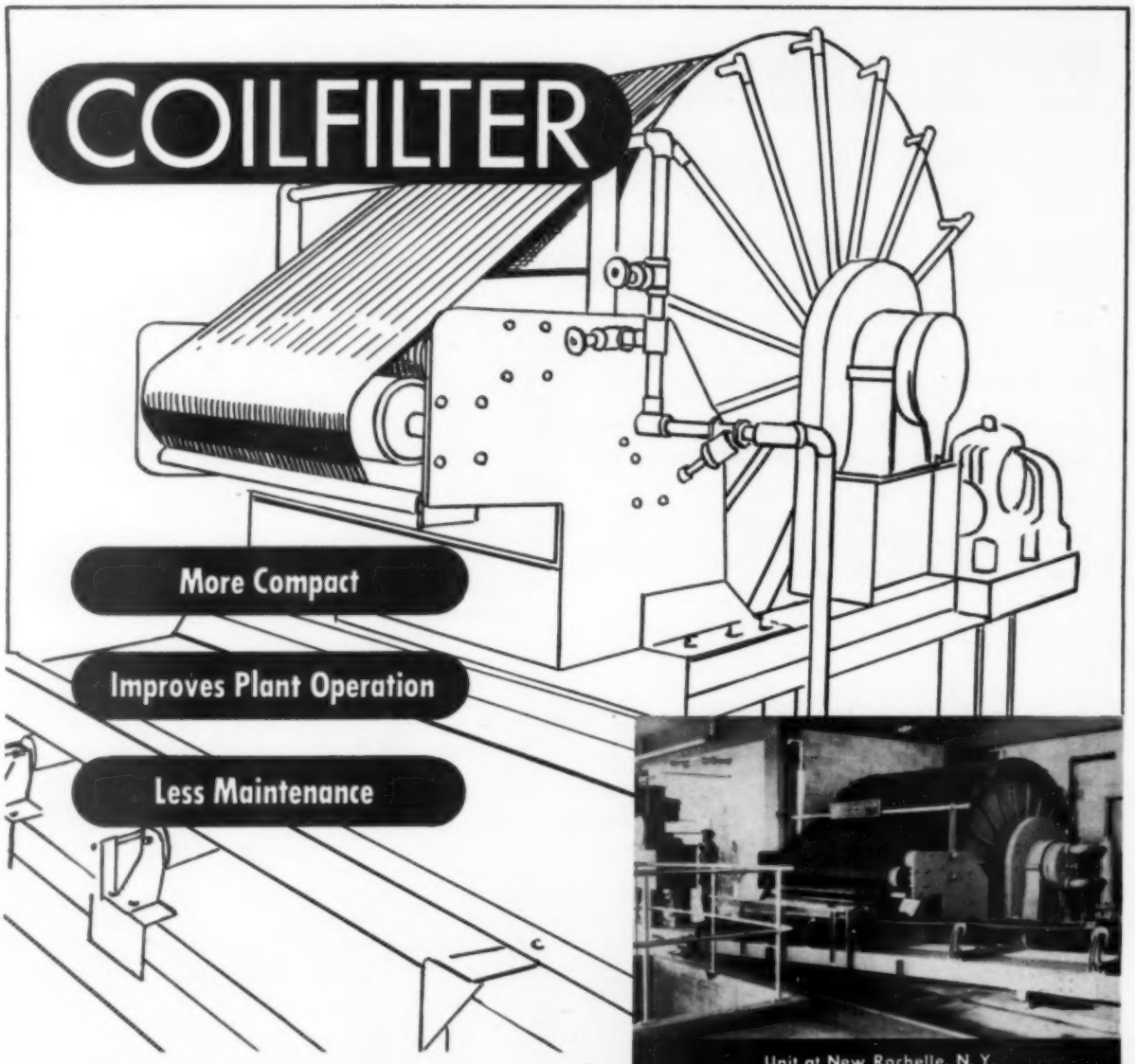
Write **Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.**

AT YOUR COMMAND...

Control Remote Operations with Builders-Providence Transistorized Supervisory Control

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
BIF METERS FEEDERS CONTROLS

COILFILTER



More Compact

Improves Plant Operation

Less Maintenance

Unit at New Rochelle, N. Y.

Unit at East Providence, R. I.

America's most modern, most efficient and most specified sludge vacuum filter in the municipal field is the COILFILTER.

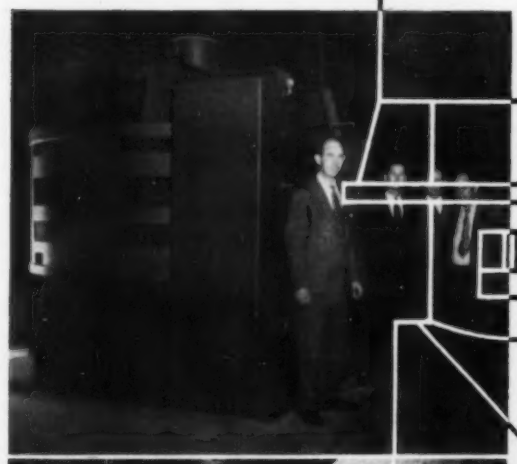
More and more communities are finding the COILFILTER the answer to their needs for a compact, attractive sewage treatment plant, incorporating low maintenance costs with constant, trouble-free operation.

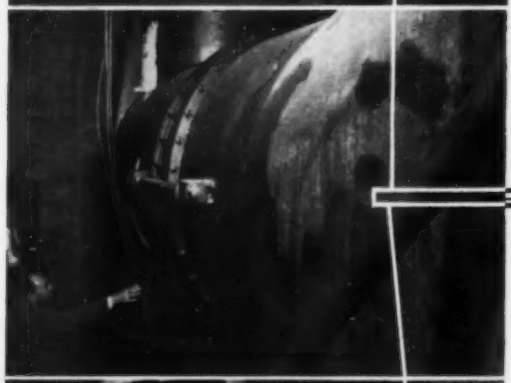
Write for the new 16 page descriptive Bulletin No. 106

KOMLINE-SANDERSON ENGINEERING CORPORATION
Peapack, New Jersey

MANUFACTURERS OF COILFILTER SLUDGE VACUUM FILTERS

GET THE BIG PUMP FOR THE BIG JOBS





PEERLESS PUMPS

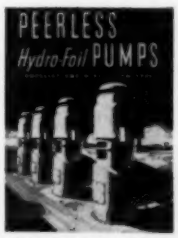
PEERLESS HYDRO-FOIL PUMPS

ON CONSTANT STANDBY FOR UNFAILING OHIO RIVER FLOOD CONTROL

A flood control pump has a big responsibility. It must become operative instantly when the emergency arises and run continually for as long as the emergency exists. That's why the U. S. Corps of Engineers used Peerless 66" and 72" Hydro-Foil pumps on a recent flood control project at Louisville, Kentucky. They know that the big Peerless Hydro-Foils are as dependable and well-built as they are large.

The Louisville project consists of 17 miles of flood wall and 14 pumping stations, all designed to handle the Ohio River when cresting above flood stage. Typical of the pumps used in the pumping stations is the huge mixed flow Hydro-Foil pictured at left. This imposing giant of the pump world is capable of moving 103,000 GPM, against a 20½ ft. head, and is powered by a vertical synchronous motor operating at 360 RPM.

This is only one of the many Peerless pumps available to all industries for every purpose—pumps that reflect the sound engineering, quality of manufacture and uncompromising performance that has made the Peerless product the finest in the field today. Whatever your liquid transfer problem is, Peerless has the answer—the right answer. Consult your phone directory for the nearest Peerless sales-engineering representative.



Write for Bulletin

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send copy of Peerless Bulletin No. B-148.

NAME_____

COMPANY_____

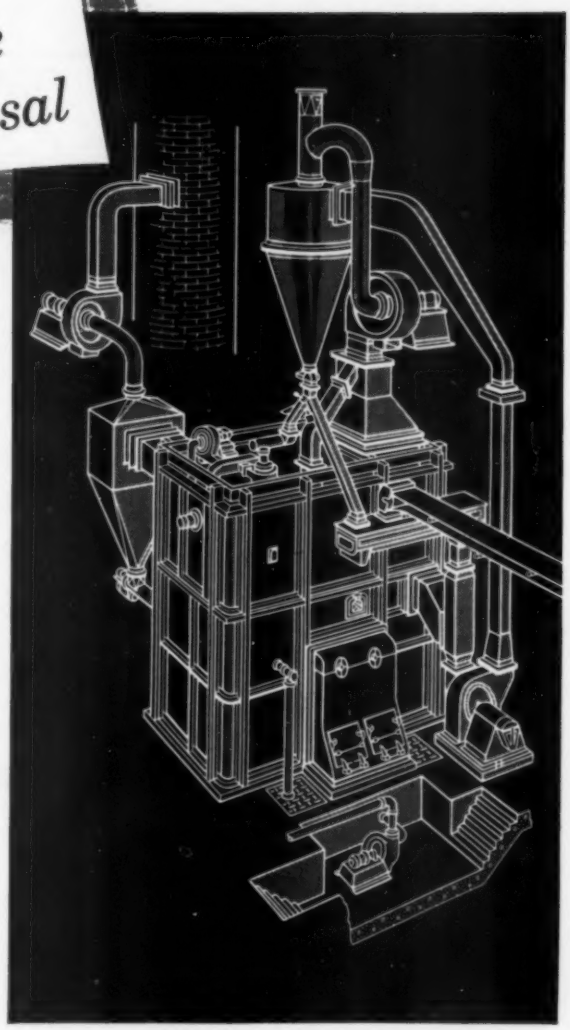
STREET_____

CITY_____ STATE_____

WSW

THE C-E RAYMOND FLASH DRYING SYSTEM...

6 reasons why it's your best choice for sludge disposal



IT OFFERS THESE FUNCTIONS:

1. Drying... Only the C-E Raymond System gives you *controlled* drying. This means that your filter cake is reduced to particles uniform in size...low and uniform in moisture content...highly suitable for use as fertilizer when sludge characteristics permit.

2. Incineration... The Raymond System provides the simplest, most efficient method of sludge incineration. It produces a sterile ash that is free of clinkers...requires less purchased fuel.

3. Deodorizing... The C-E Raymond System is the only one that offers high temperature deodorization to remove foul odors from combustion gases, as well as from sludge holding tanks.

WITH THESE FEATURES:

4. Superior Structure... Instead of relying on multiple refractory arches, the C-E Raymond System utilizes small groups of arch bricks individually hung from steel supports above and outside the furnace. This not only makes arch failure virtually impossible, but permits very rapid start-ups and shut-downs... offering important man-hour and fuel savings.

5. Economical Operation... This system has a proved record of low maintenance costs. Not only is maintenance negligible, but the revenue gained from the sale of flash-dried sludge as fertilizer can help pay the operating costs of your plant.

6. Proved Dependability... More than a quarter of a century of use and development in plants throughout the United States and abroad has shown the capability of the C-E Flash Drying System.

More filter cake is dried and/or burned in this system than by all other systems combined.

For detailed information on the C-E Raymond Flash Drying System, and how it can benefit your community, contact the Combustion office nearest you. A C-E specialist will be glad to discuss your requirements with you or your consultants.

COMBUSTION ENGINEERING

RAYMOND DIVISION, 1315 North Branch Street, Chicago 22, Illinois

Eastern Office: 200 Madison Avenue, New York 16, N. Y. • Western Office: 510 West Sixth Street, Los Angeles 14, Cal.

Canada: Combustion Engineering-Superheater Ltd.

C-E

C-107

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

Good Water is a . . .

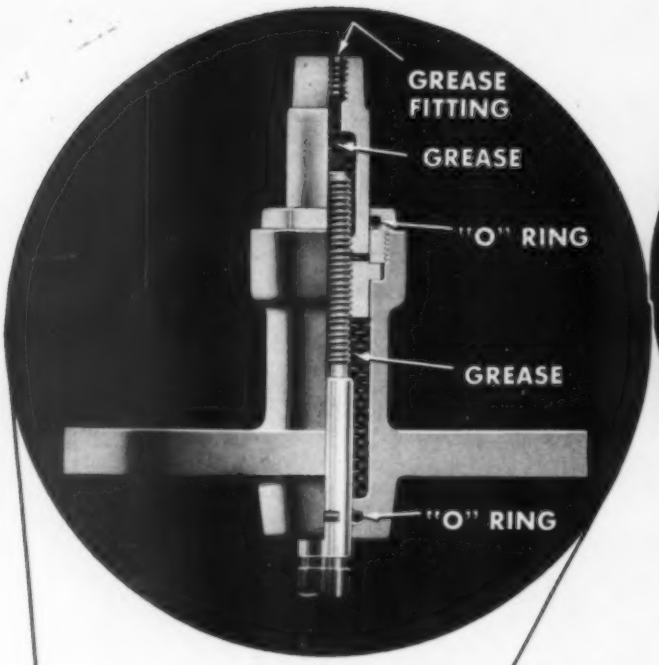
Longtime Investment

. . . ample reason why the dependability of the mechanical equipment is of real importance.

Roberts-equipped plants are noted for their year-in, year-out efficient operation.

Choose Roberts Filter, and be sure.

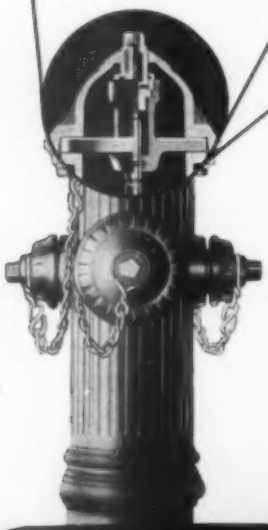
MECHANICAL EQUIPMENT
BY
ROBERTS FILTER MFG. CO.
DARBY, PENNA.



NEW DOUBLE FEATURE

SMITH[48] HYDRANTS

WITH "O" RING-SEAL AND GREASE CHAMBER FOR OPERATING THREADS

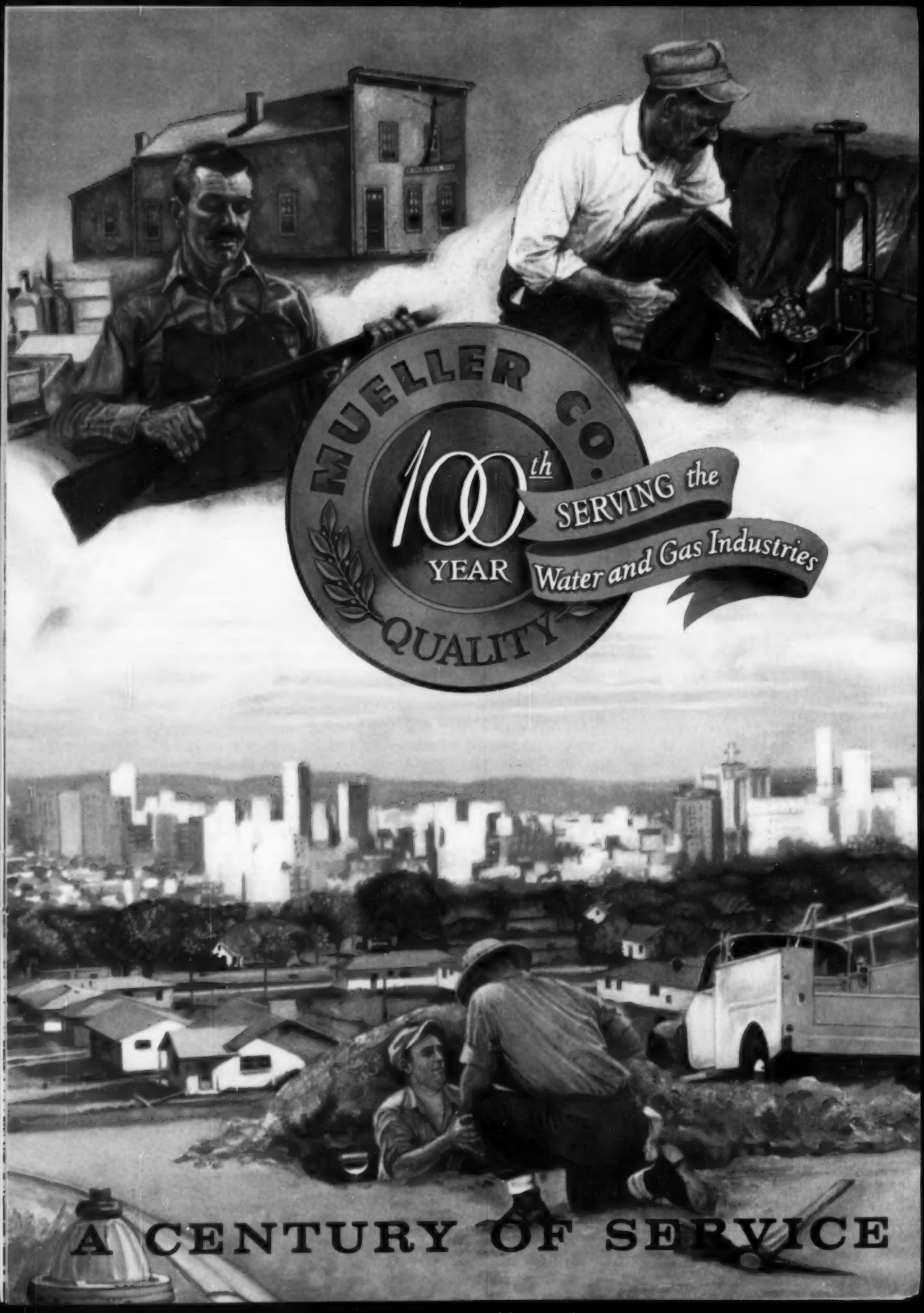


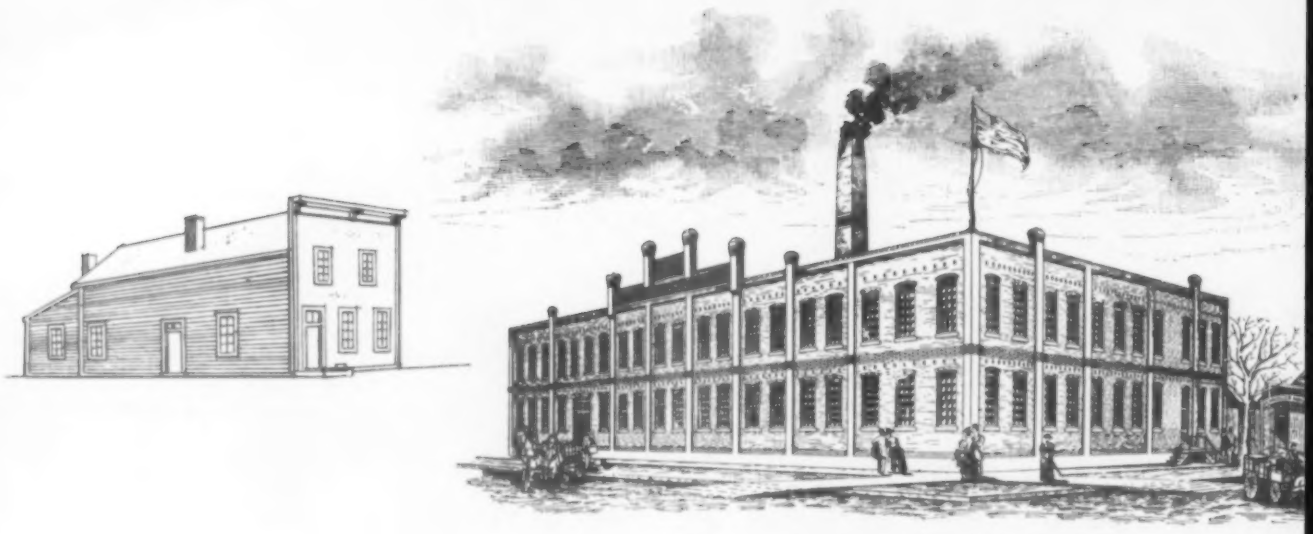
When you specify "O" Ring Seals rather than conventional packing you reduce maintenance to a minimum. The lower "O" Ring is the pressure seal, the upper "O" Ring the dirt seal. The initial compression of the "O" Rings provides the seal when the hydrant is closed. When subject to water pressure the lower "O" Ring is forced to the top of the groove. The sealing force increases as the pressure increases. The specially compounded rubber plastic "O" Rings insure a long life pressure seal. Each time the hydrant is operated, the "O" Ring Seals, the bearing surfaces, and the operating threads are automatically lubricated. Threads and upper section of the stem are continuously lubricated and sealed from contact with water in the standpipe. The lubricant is suitable for temperatures of minus 30 degrees to 200 degrees. All Smith Hydrants including hydrants in service can be fitted with "O" Ring Seal Plates.

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE. NEW JERSEY


MUELLER CO.
100th
YEAR
SERVING the
Water and Gas Industries
QUALITY
A CENTURY OF SERVICE



ONE HUNDRED YEARS AGO...

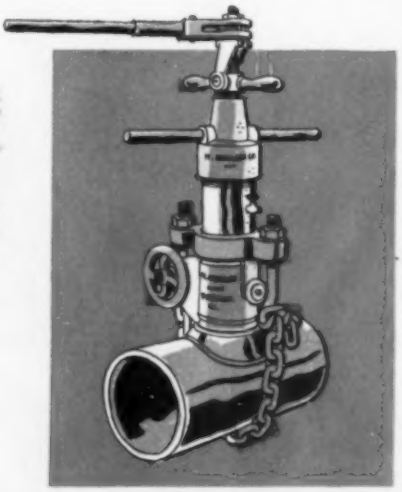
In the fall of 1857, Hieronymus Mueller came to Decatur, Illinois. Opposite the town's livery stable, he opened a one-man shop, making guns and tools and repairing anything mechanical. Mueller's inventive mind and insistence on perfection gained many customers, and the shop prospered.

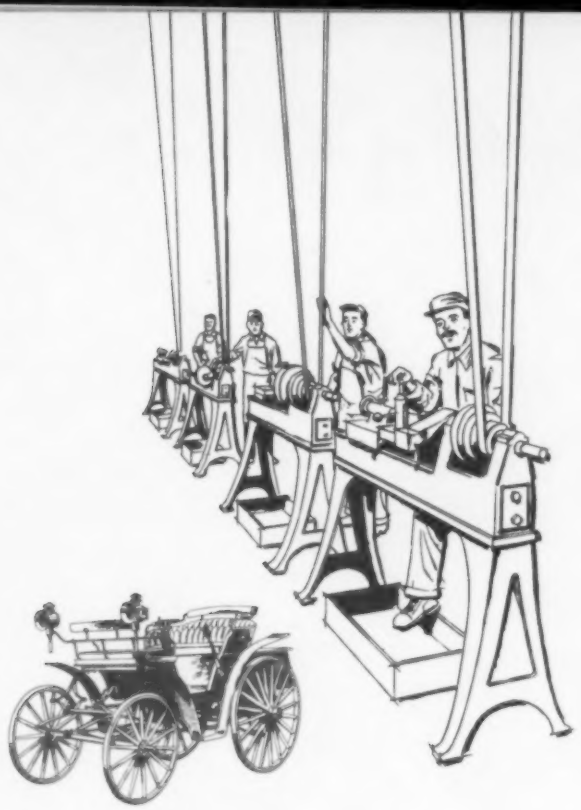
In 1871, Mueller was appointed plumber for the city of Decatur. In those days, the comfort and convenience of running water in the home was possible only after a cumbersome, troublesome service connection was made to the main. The plumber drilled a hole, almost through the main, with a crow and ratchet. A corporation "drive" stop was inserted and was secured in the main by a sharp blow with a sledge—if the blow hit true. If the blow missed, the plumber was drenched and the ditch filled with water, necessitating an interruption in service to all customers while pressure was reduced and the connection made.

Mueller went to work to devise a more efficient method. After weeks of experimenting, he devised the original "B" Tapping Machine, permitting plumbers to drill through the main and insert a corporation stop under pressure, without loss of water. A vital need of an expanding industry had been answered—the first of many answers for gas and water problems through a century of progress.

The "B" Machine established Mueller in the manufacturing field and a new, three-story factory replaced the one-room shop. Sixteen men kept working full time to turn out an annual volume of $25,000 worth of water and gas distribution products. The demand for the luxury of running water and gas for cooking and heating was growing rapidly. By 1896, manufacture of products for these industries had become so important that the original shop was sold.

It was in this era that Mueller became interested in





the new horseless carriage. He developed several innovations for the automobile, including variable-speed transmission, body suspension, water-cooling radiators, spark plugs and breaker circuit. Some of his original, patented ideas are still in use. Hieronymus, convinced of the future of this new invention, made plans to manufacture an automobile. But a gasoline explosion in a workshop on March 1, 1900, ended his life and ended the company's plans for the automotive field.

Mueller's sons assumed the leadership and continued the progress charted by the company's first president. Mueller Co. grew in service, in products, in employees and facilities.

New products were introduced to meet the needs of the gas and water industries and old products were constantly improved. All were tried and tested to the standard of superior mechanical performance and manufacturing perfection that was established one hundred years ago by Hieronymus Mueller.

MILESTONES OF PROGRESS

1857 —Hieronymus Mueller opens general machining and manufacturing shop in Decatur.

1871 —Mueller appointed city plumber.

1872 —First tapping machine invented.

1872 —New Mueller factory erected.

1882 —Invented water pressure regulator.

1882 —Mueller joins AWWA—one of the first five members.

1885 —Large scale manufacturing of brass goods started.

1893 —H. Mueller Mfg. Co. incorporated.

1895 —First building erected at present Decatur plant location.

1895 —Hieronymus Mueller wins first American auto race with car imported from Germany and rebuilt.

1900 —Hieronymus Mueller passes away, March 1.

1902-3 —Decatur plant enlarged.

1905 —Eastern Division with offices in New York established.

1907 —Golden Anniversary Year. "Mueller" trademark registered.

1912 —Mueller, Limited, organized with plant at Sarnia, Ontario.

1917-18—Munitions and other war goods manufactured for allies.

1923 —Los Angeles branch established.

1924 —Company name changed to Mueller Co.

1924 —Copper pipe and fittings added to Mueller line.

1924 —Plant No. 2 in Decatur added.

1932 —Mueller's 75th Anniversary year.

1933 —Chattanooga manufacturing facilities acquired.

1933 —Steel Tees perfected—providing gas companies with simple, speedy service installations.

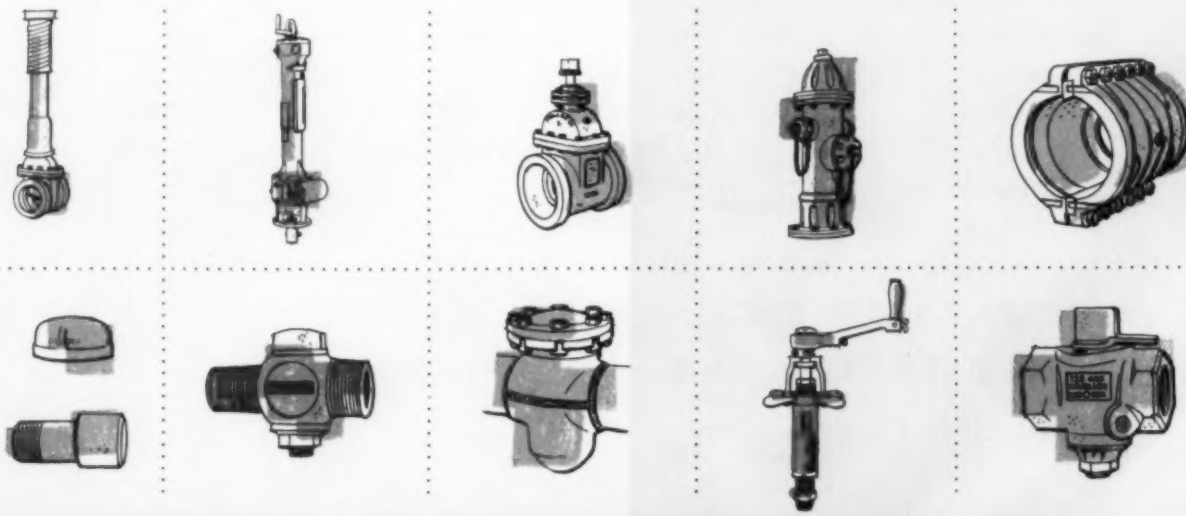
1938 —Line stopper fittings and equipment developed for work on gas or oil lines under pressure.

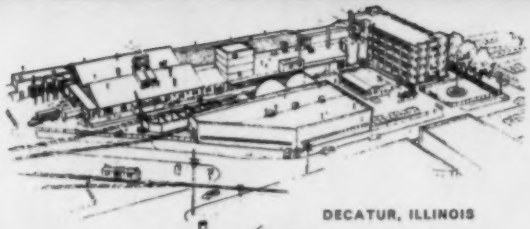
1941-45—Production of war materials claims manufacturing facilities of all plants.

1949 —Full line of No-Blo® equipment presented to the gas industry.

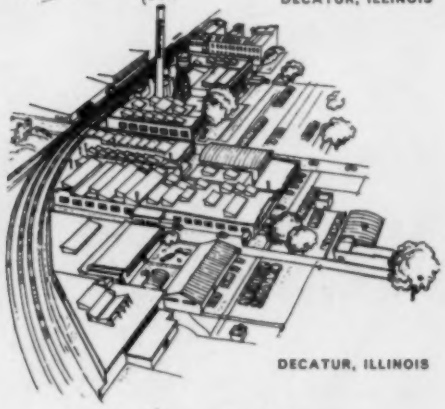
1950 —Tamper-proof gas stop introduced.

1957 —Mueller's 100th year of service to gas and water industries.





DECATUR, ILLINOIS



DECATUR, ILLINOIS

MUELLER® TODAY...

Mueller Co. looks to the future as it meets the needs of today.

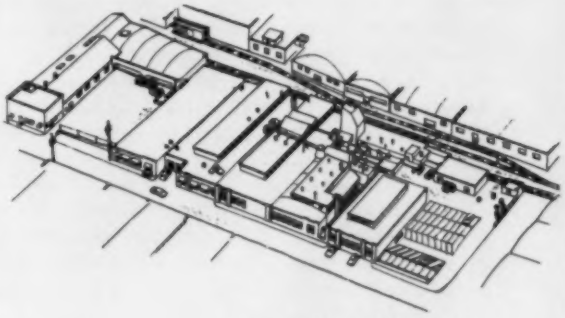
Mueller design and research engineers are already working on tomorrow's problems of the gas and water industries, developing new products and improving current ones.

Five modern factories hum with activity as they manufacture products for our rapidly-expanding gas and water industries. Precision machines and skilled workers insure strict adherence to Mueller's age-old standard of perfection.

A staff of trained salesmen is always available to assist in the selection, application and operation of Mueller products.

Upon the firm foundation established 100 years ago, Mueller management of today is building for tomorrow—for a second century of service to the water and gas industries!

CHATTANOOGA, TENNESSEE



LOS ANGELES, CALIFORNIA

SARNIA, ONTARIO

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario.

MUELLER CO. 100th YEAR SERVING the Water and Gas Industries QUALITY

Since 1857

CLOW
BELL-TITE
CAST IRON PIPE

costs less to buy, less to lay!

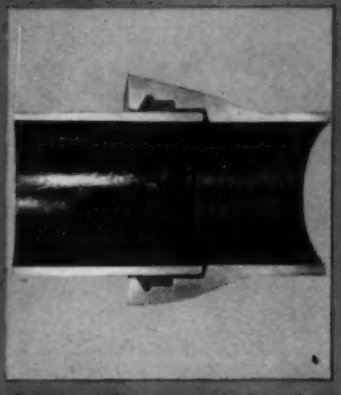
Assembly is simple. First, the joint is wiped clean.

Second step — insert gasket as shown into groove in bell.

Third — apply thin film of special lubricant to the gasket.

Next—push home the spigot, first centering plain end in bell.

No bell holes are required. Installation is very rapid.



Result—a safe, economical joint with a tight, permanent seal.

The NEW CLOW BELL-TITE cast iron pipe joint is a rubber seal joint that requires NO bolts, NO nuts, and requires NO wrenches to lay. It takes less time to install. It costs less to buy. Here's economy PLUS.

The Underwriters' Laboratories, after testing the joint, have approved its use for water working pressures up to 350 psi. CLOW BELL-TITE pipe barrel meets all quality provisions and physical requirements of all applicable ASA, AWWA, and/or Federal Specifications for cast iron pipe.

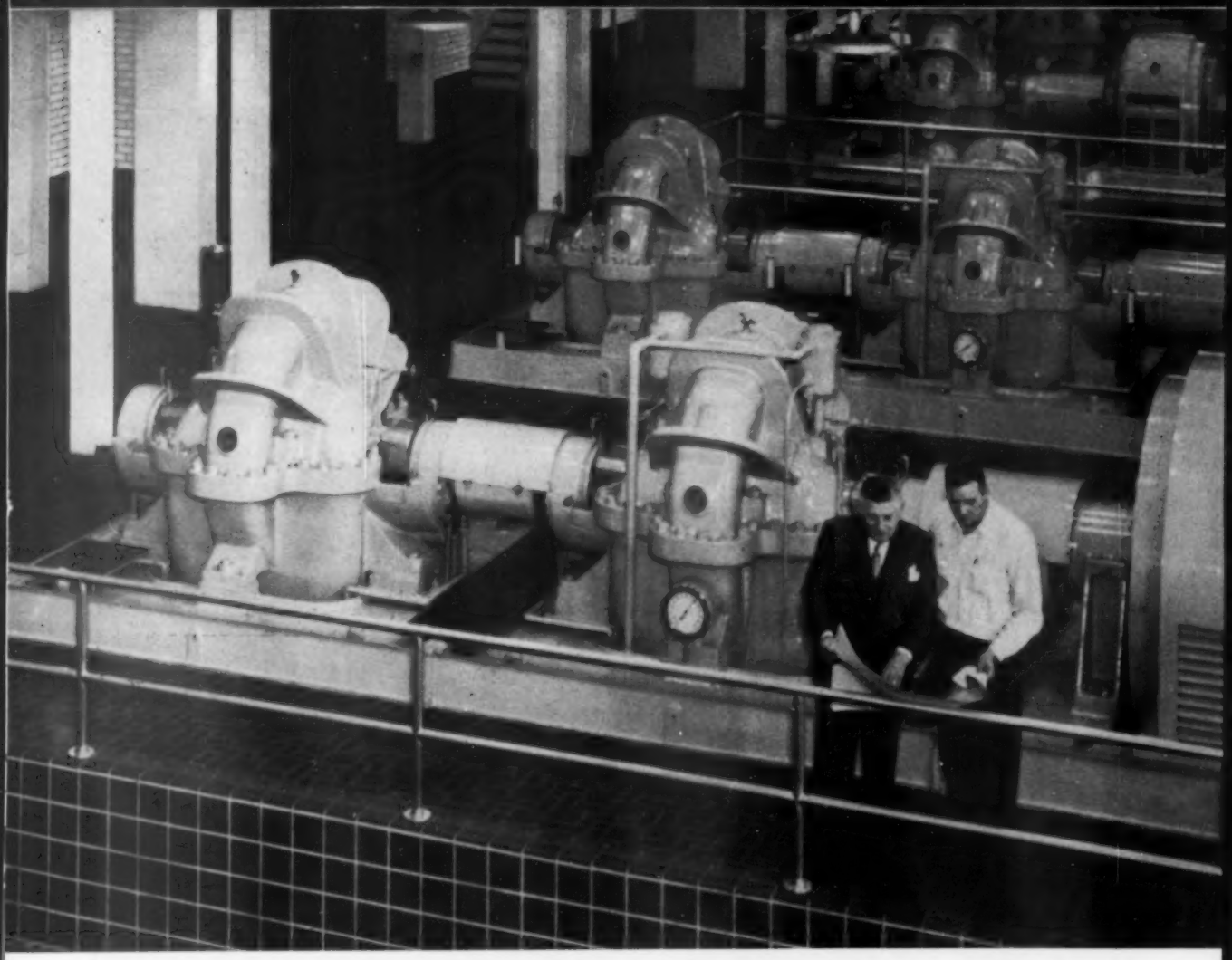
SINCE 1878

JAMES B. CLOW & SONS, INC.

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries: Eddy Valve Company, Waterford, New York • Iowa Valve Company, Oskaloosa, Iowa

Earle Vinnedge, Worthington Corp., and Lou Motz, Pumping Station Supervisor, Cincinnati Main Pumping Station, check performance of Worthington pumps installed in 1957. Earle represented one contact—one responsibility for the pumping equipment. We believe you too will find it advantageous to deal with the Man from Worthington. Cincinnati Water Works. Main Pumping Station. Consultants: Black and Veatch. Kansas City, Mo.



.5 MGD TO 500 MGD

Any size, you have more to choose from with Worthington

These Freflo sewage pumps typify hundreds of Worthington equipped treatment plants.

You benefit two ways when you deal with Worthington – world's leading builder of public works equipment.

An unbiased recommendation. Because Worthington makes all types of pumps and drives and a complete line of engines, compressors, comminutors and auxiliary equipment, you get equipment recommendations based on a broad look at all ways of doing the job. You have a choice, for example, of either vertical or horizontal centrifugal pumps. In many other ways – some small, some major – the Worthington line lets you tailor the equipment to the specific requirements of your plant.

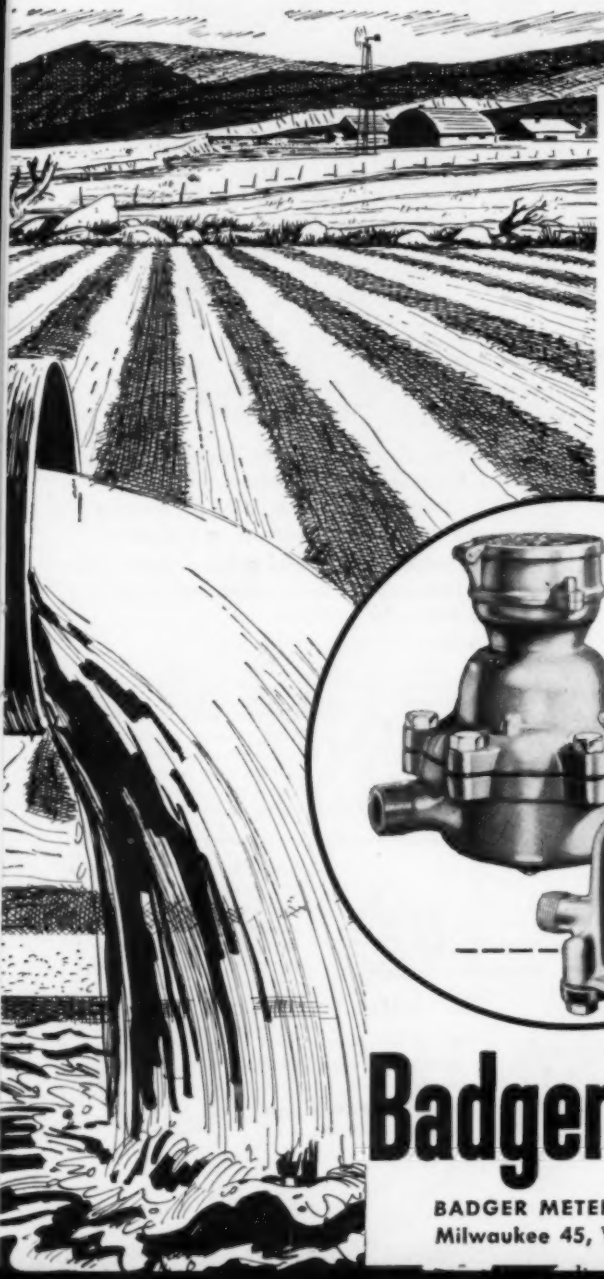
Unit responsibility. You do business with one company—eliminating delays and inconvenience that can occur when you are forced to coordinate the efforts of several suppliers. Unit responsibility by Worthington saves you time and money.

Small or large, you'll do better by consulting Worthington. For more information call your nearest Worthington District Office. Or write to Section W-71, Worthington Corporation, Harrison, N. J.

WORTHINGTON

Soil conserved . . .

but how about our most precious possession . . . water?

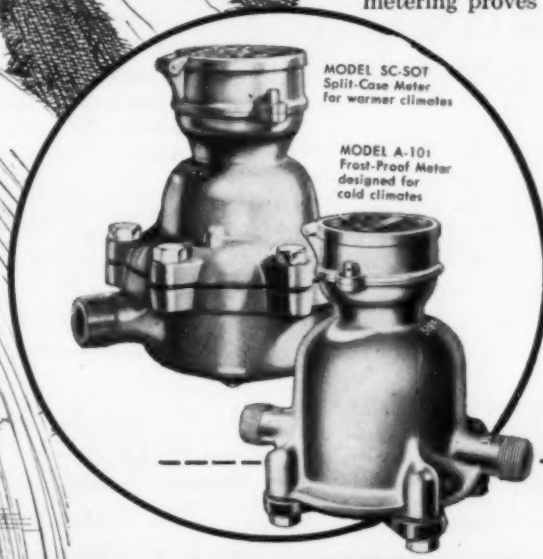


Stop water waste . . . start water conservation now—with Badger Meters

We are paying billions for land conservation and reclamation because our very life depends upon it. And we are lucky — there's land to reclaim. But what about our diminishing water supply? When that's gone — then what?

That's why the time to start water conservation is *now*—with Badger Meters. They're the best investment you can make for your community's future. Badger Meters replace impractical and unjust flat rates with a fair-share, fair-pay program for everybody. Accurate metering proves to consumers that the best things in life are far from free. *That's* when water waste stops — conservation begins. What's more, Badger Meters put your water system on a profitable, business basis.

Choose the specific meters you need from the complete Badger Meter line of outstanding disc, turbine and compound meters — $\frac{5}{8}$-inch through 12-inch sizes. They're precision-engineered, using the finest alloys for lasting, accurate service. Call a Badger Meter representative for facts — or write for literature *today*.



Badger Water Meters

Water is vital

Badger Meters have conserved it better for over 50 years.

BADGER METER MFG. CO. • 2371 North 30th Street
Milwaukee 45, Wisconsin • OFFICES IN PRINCIPAL CITIES

TENNESSEE CORPORATION

Ferri-Floc
FERRIC SULFATE

Ferri-Floc
FERRIC SULFATE

The Superior COAGULANT *With The Plus* FACTORS—

- Excellent taste and odor control
- Increased filter runs
- Coagulation over wide pH ranges
- Rapid floc formation • Economy
- Turbidity removal • Color removal
- Manganese and Silical removal
- Bacteria removal
- Ease of Operation

Ferri-Floc gives smoother, more efficient and trouble free operation. Whatever your particular water treatment problem may be, you can depend on Ferri-Floc doing a superior job and doing it efficiently and economically—Ferri-Floc is a free flowing granular salt which can be fed with few modifications through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy handling as well as storage in closed hoppers over long periods of time.

WATER TREATMENT

Efficient coagulation of surface or well waters. Aids taste and odor control—Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial waters.

SEWAGE TREATMENT

Ferri-Floc coagulates water and wastes over wide Ph ranges—it provides efficient operation regardless of rapid variations of raw sewage and is effective conditioning sludge prior to vacuum filtration or drying on sand beds.

SULFUR-DIOXIDE HIGHEST QUALITY SO_2

SULFUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE

COPPER SULFATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Let us send you without charge, a 38 page booklet that deals specifically with all phases of coagulation — just send us a postal card.

TENNESSEE CORPORATION

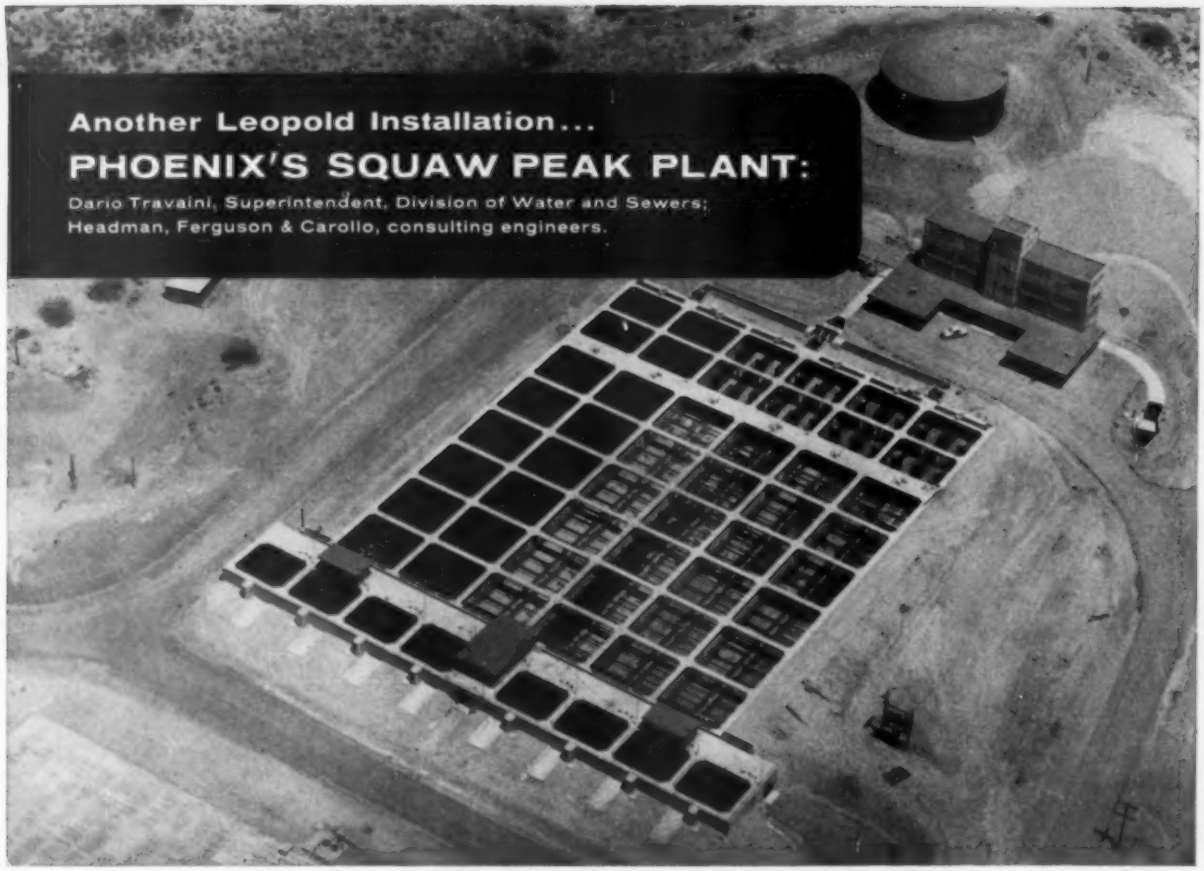
617-29 Grant Building, Atlanta, Georgia

FOR THE BEST IN *Water Meters* go ALL AMERICAN

AMERICAN METERS *Reduce Maintenance Costs*

Here are three factors that help reduce maintenance time and parts costs: 1) American Meters are simple in construction, have a smaller number of parts, which are simple in design. 2) It's easy to take the meter apart or reassemble it . . . no errors possible. 3) Fullest interchangeability of parts. You don't have to purchase assemblies. The same chambers are used in frost bottom or solid casing meters. Oil enclosed and open gear trains are interchangeable. No "Unit assemblies" of parts needed when you "go all AMERICAN."

BUFFALO METER CO.
2909 MAIN STREET BUFFALO 14, NEW YORK


Another Leopold Installation...
PHOENIX'S SQUAW PEAK PLANT:
Dario Travaini, Superintendent, Division of Water and Sewers;
Headman, Ferguson & Carollo, consulting engineers.

Second Water Filtration Plant for Phoenix, Arizona, also uses **LEOPOLD FILTER BOTTOMS**

To solve the problem of an unusually heavy summertime demand for water, the City of Phoenix constructed, and now has in operation, an additional 30-mgd water filtration plant. Located about ten miles north of the city, this Squaw Peak plant cost over 2¼ million dollars. Although it is presently used only during the summer months, it represents an important step in Phoenix's long range plan of water works improvement and expansion.

For these up-to-date facilities, Leopold glazed tile filter bottoms are being used. They were selected because of their past successful performance in the city's Verde plant—also of 30-mgd capacity.

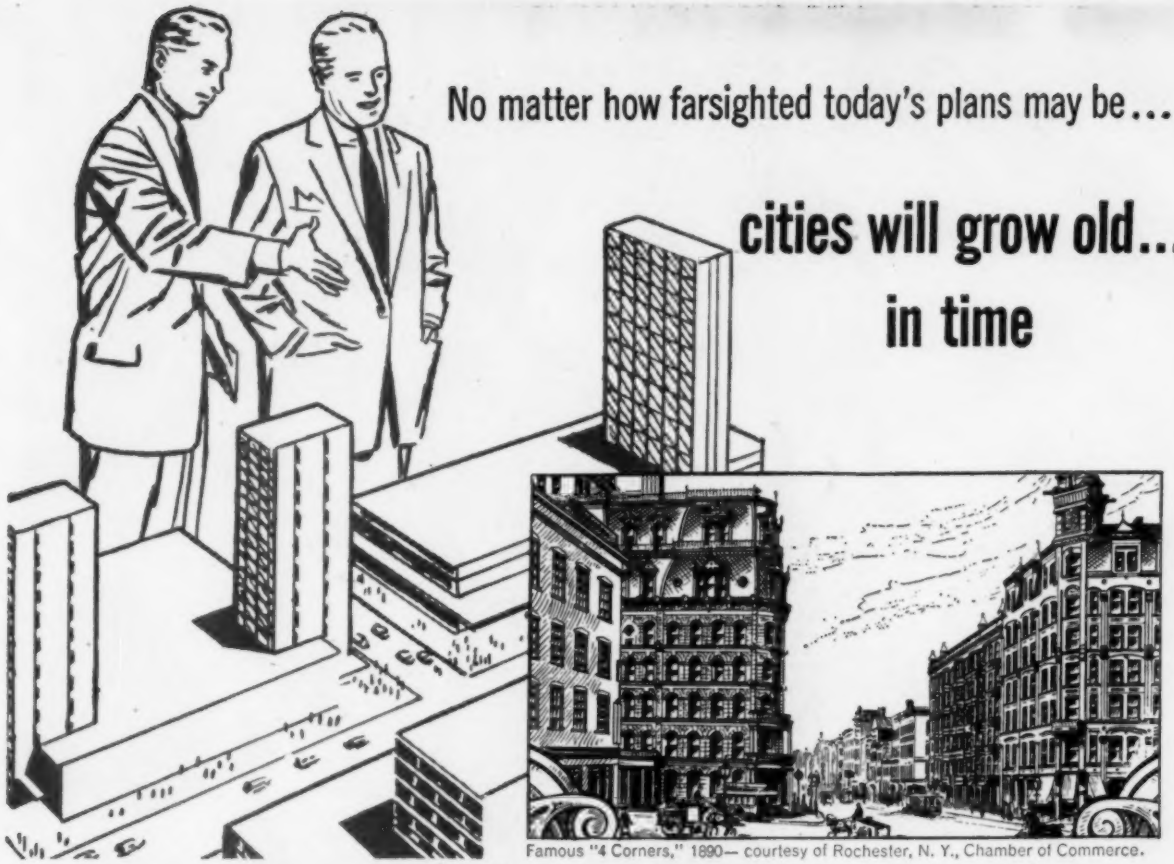
Whether for new construction or plant modernization, an increasing number of municipalities are installing Leopold water purification and filter plant equipment. And for good reasons, too. We'd like to give you details—without obligation.

Leopold

For Top Performance—Use Leopold Bottoms!

F. B. LEOPOLD CO., INC.
ZELIENOPLE, PA.

COMPLETE WATER PURIFICATION AND FILTER PLANT EQUIPMENT · BUTTERFLY VALVES
FILTER OPERATING TABLES · MIXING EQUIPMENT · DRY CHEMICAL FEEDERS
GLAZED TILE FILTER BOTTOMS



No matter how farsighted today's plans may be...

cities will grow old... in time

Famous "4 Corners," 1890— courtesy of Rochester, N. Y., Chamber of Commerce.

Your best insurance against obsolescence of your water system... specify EDDY Valves and Hydrants *throughout*

No matter how far into the future your city planning is projected, Eddy's record testifies that Eddy Valves and Hydrants are your best long term investment. Eddy Valve Company's more than 100 years of dependable operation means that, today, you can get replacement parts for any Eddy Valve or Hydrant ever installed. And our ability to continue to do so is your assurance against future obsolescence of your valves and hydrants.

EDDY Bronze-Mounted HYDRANTS open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below hydrant valve means that there is no water loss due to a bent stem.

EDDY Bronze-Mounted GATE VALVES offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, tell why progressive water works men have relied on Eddy for generations.

Eddy Hydrants and Valves are available with hub, flange or mechanical joint connections to fit any existing or planned installation.

Send today for full data on the complete line of Eddy Valves and Hydrants. No obligation.

EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK

How safe?

Life-giving fluid . . . *or death-dealing poison?*

Better than anyone else, you know what it takes to keep that clear, sparkling water *safe* for your community. Your skill is in that glass.

So is the skill of your chlorine supplier. How solidly can *you* count on the chlorine you buy—its purity; packaging; the promptness with which it reaches you when you need it?

We're in that glass, too. The very first liquid chlorine made in this country carried the NIALK® label. Today, as always, when you buy NIALK chlorine, you get a 100% pure product in clean, well-conditioned containers with safe, tested, smooth-functioning valves.

You can order it in 100- and 150-lb. cylinders, in multi-unit cars of ton containers, and in tank cars of 16-, 30-, and 55-ton capacity.

Your inquiry will receive our prompt attention.

For safe, efficient, chlorine handling in your plant, write for these two helpful timesavers:

1. *New Hooker chlorine wall chart* lists the most important precautions for handling chlorine; tells what to do in case of accident.

2. *Complete 76-page chlorine manual* gives detailed engineering and safety information. It is fully illustrated with diagrams of equipment for handling chlorine.

HOOKER ELECTROCHEMICAL COMPANY
1709 Union Street, Niagara Falls, N. Y.

HOOKER CHEMICALS PLASTICS

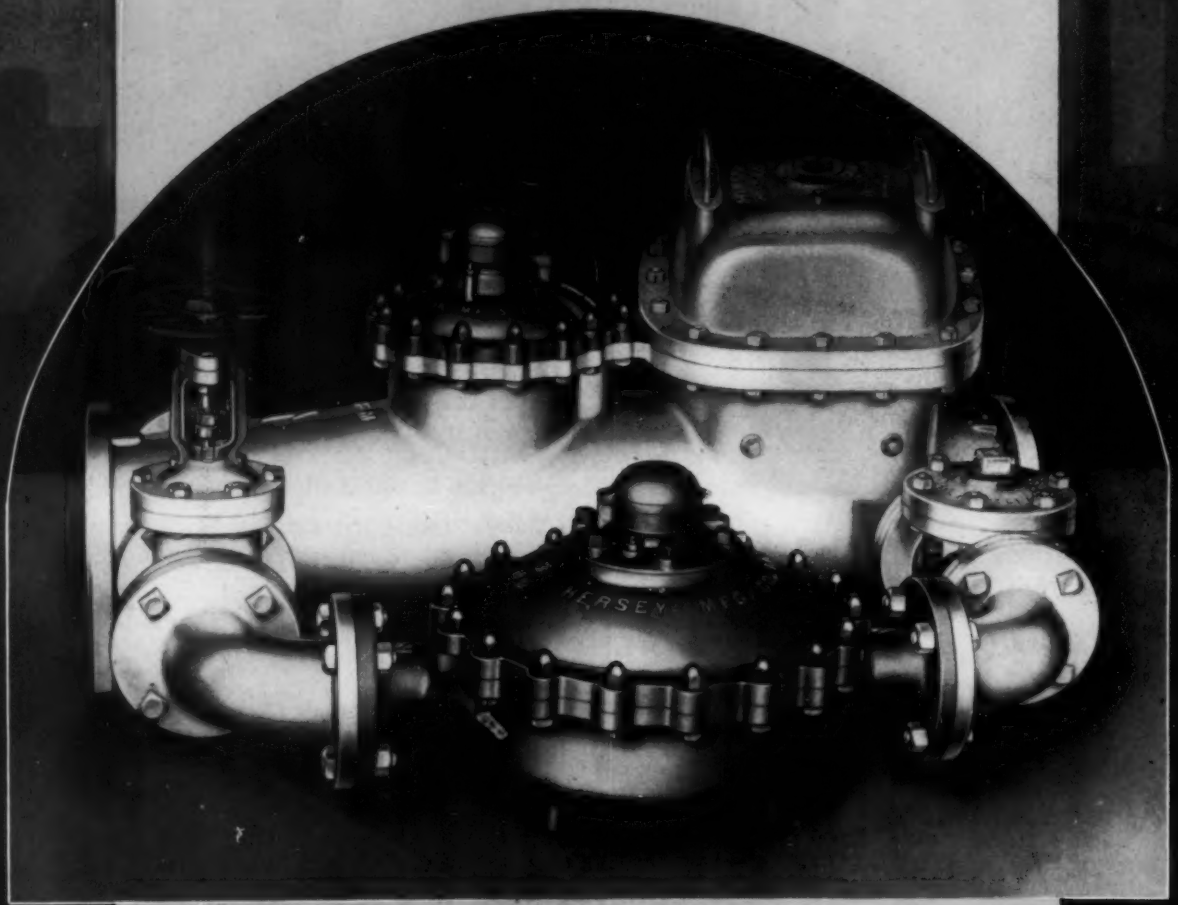
DUREZ® PLASTICS DIVISION • NORTH TONAWANDA, N. Y.
NIALK® CHEMICALS • NIAGARA FALLS, N. Y.
OLDBURY® CHEMICALS • NIAGARA FALLS, N. Y.

Sales Offices: Chicago, Ill.; Detroit, Mich.; Los Angeles, Calif.; New York, N. Y.; Niagara Falls, N. Y.; Philadelphia, Pa.; Tacoma, Wash.; N. Tonawanda, N. Y.; Worcester, Mass. *In Canada:* Hooker Chemicals Limited, N. Vancouver, B. C.

There is no satisfactory
substitute for

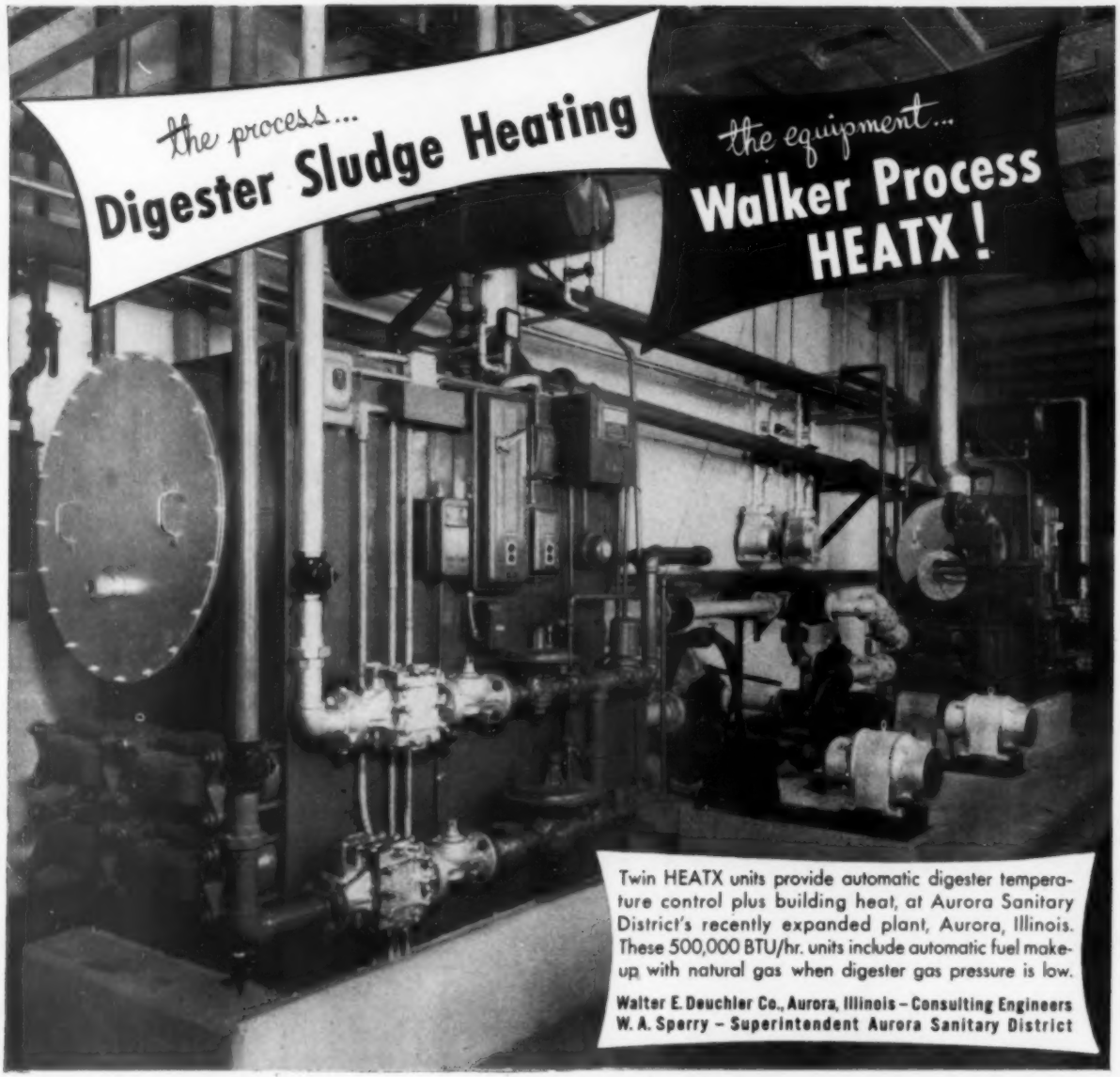
HERSEY

Detector (Fire Service) **Meters**
where <u>accurate</u> measurement of
<u>all</u> rates of flow is required



HERSEY MANUFACTURING COMPANY
DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA
DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES



Twin HEATX units provide automatic digester temperature control plus building heat, at Aurora Sanitary District's recently expanded plant, Aurora, Illinois. These 500,000 BTU/hr. units include automatic fuel make-up with natural gas when digester gas pressure is low.

Walter E. Deuchler Co., Aurora, Illinois – Consulting Engineers
W. A. Sperry – Superintendent Aurora Sanitary District

Automatic digester temperature control ■ 180°Boiler heat for building heat

HEATX

140°Exchanger temperature prevents sludge caking
Adaptable to waste heat utilization
Exclusive rifled sludge return bend castings
Maximum efficiency using digester gas and/or natural gas or fuel oil

The Walker Process HEATX provides the *complete unit* for your digester sludge heating process. Concentric tube heat exchanger, fire tube boiler and control panel are combined to give absolute control over each function. Exclusive ***rifled*** sludge return bend castings cause sludge to spiral through the exchanger tubes – better K value – wall scouring prevents slime and grease adhesion. ■ The HEATX is available in standard sizes ranging from 100,000 to 2 million BTU/hr. output. Bulletin 24 S82 gives complete description of type EB (with boiler) and type E (without boiler)

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.
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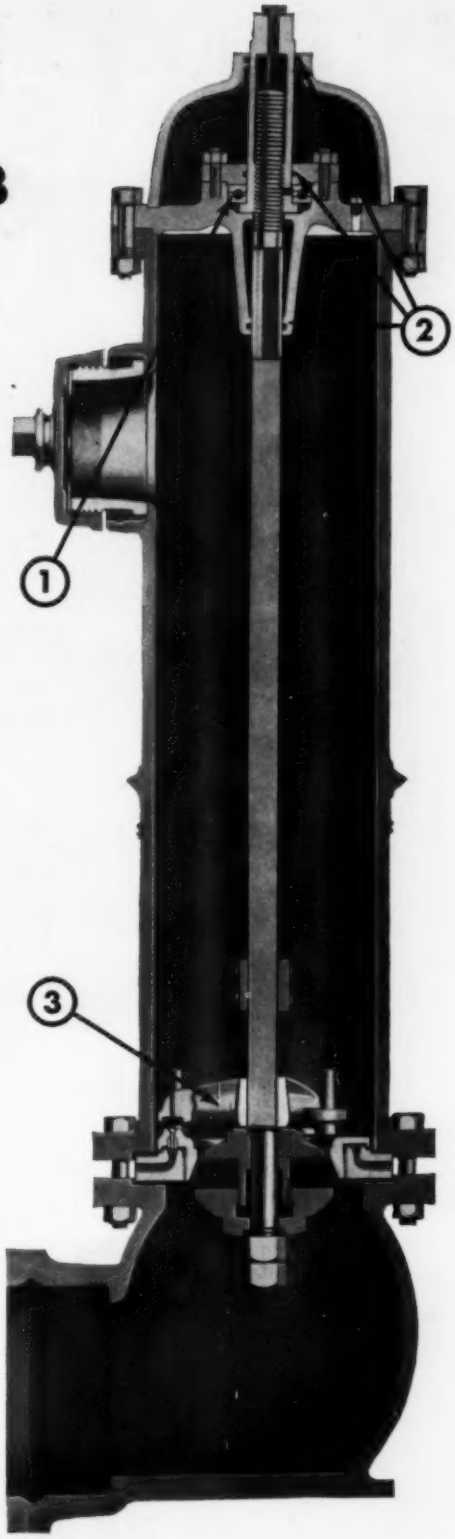
How DARLING B-50-B Hydrants

cut risk and expense!



THE new Darling B-50-B is proving in city after city that it is today's truly outstanding hydrant—the easiest and least expensive to maintain . . . and the most dependable in meeting year-around conditions as they really *are!* Of the various features that contribute to such performance, here are three of major significance . . .

1. BALL BEARING DESIGN. It takes less than half the usual force to open and close this hydrant! Operation is easy, smooth, fast and *sure,* regardless of weather extremes.

2. "O" RING SEALS. This is a packless, *dry-top* hydrant! No stuffing box . . . no packing gland adjustment or maintenance . . . no bothersome lubrication or replacement of packing. Operating threads and bearings *stay* lubricated . . . and not a drop of water ever reaches them. No *opportunity* for trouble!

3. POSITIVE DRAINAGE, WITH AUTOMATIC FLUSHING. This effective, multi-port drainage feature makes freeze-ups virtually impossible. Drain valves are always open when the main valve is closed. During first several turns in opening and last several turns in closing, drain ports remain open temporarily, flushing ports under full line pressure.

With these and other superior design features, Darling B-50-B Hydrants offer exceptional surety in both performance and economy. It will pay to make them *your* choice. They are available in types and sizes for every normal and unusual requirement. Write for Bulletin 5403.

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Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

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-users in the millions attest to their long, trouble-free life

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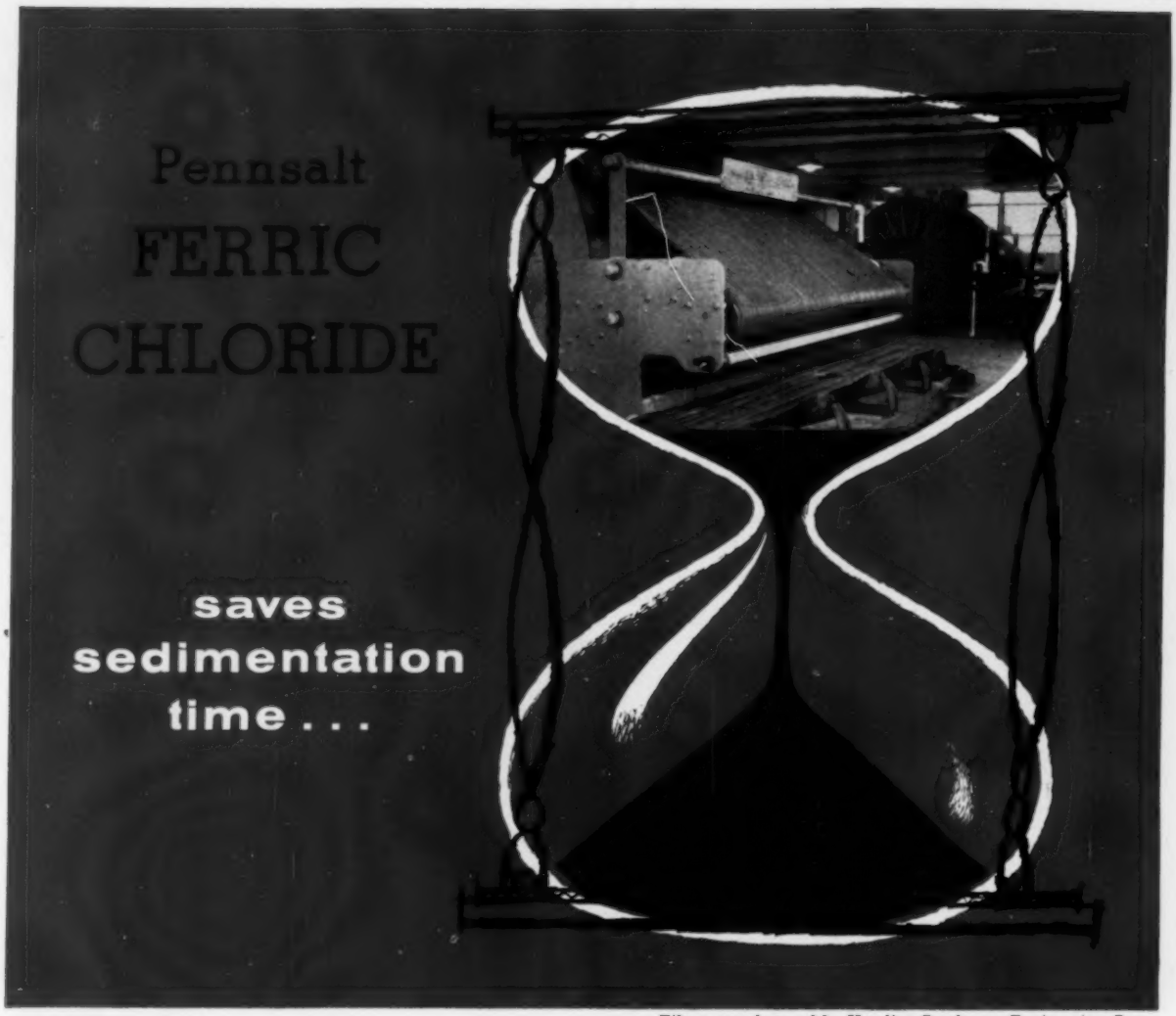

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Anhydrous $FeCl_3$ is available in non-returnable steel drums of 135 and 350 lbs.; liquid $FeCl_3$ is shipped in tank cars. Contact your nearest Pennsalt sales office for full technical information on Ferric Chloride and other chemicals for water purification and sewage: Chlorine, Alum, Perchloron®, and Ammonia.

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Delaware River intake to Tidewater Oil Company's refinery near Delaware City, Delaware, is served by this line of Jeffrey traveling water screens.

Three sets of Jeffrey screens—each screen served by a 34,375 gpm pump—remove floating debris and suspended matter from saline water drawn into the refinery. They are rated at two feet-per-second velocity through clean wire mesh at maximum flow and at minimum water depth.

Controls are manual or automatic. Automatic controls can be set for any differential head loss of from 0" to 24" and working at ten to twelve feet in tide variation. Jeffrey sanitation engineers worked with C. F. Braun & Co., Engineers, in planning the installation.

Equipment for preparing and reclaiming water for industrial uses is available from Jeffrey. Our engineers have many years' experience in planning and designing systems for power plant cooling water, pulp and paper process water. Catalog 905 describes this equipment. The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

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JEFFREY

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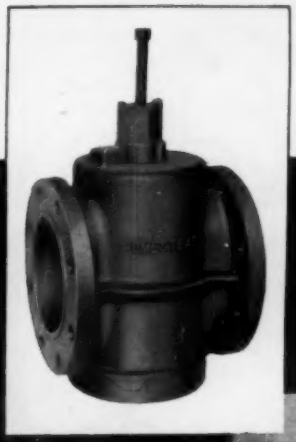

- 100% Pipe Area
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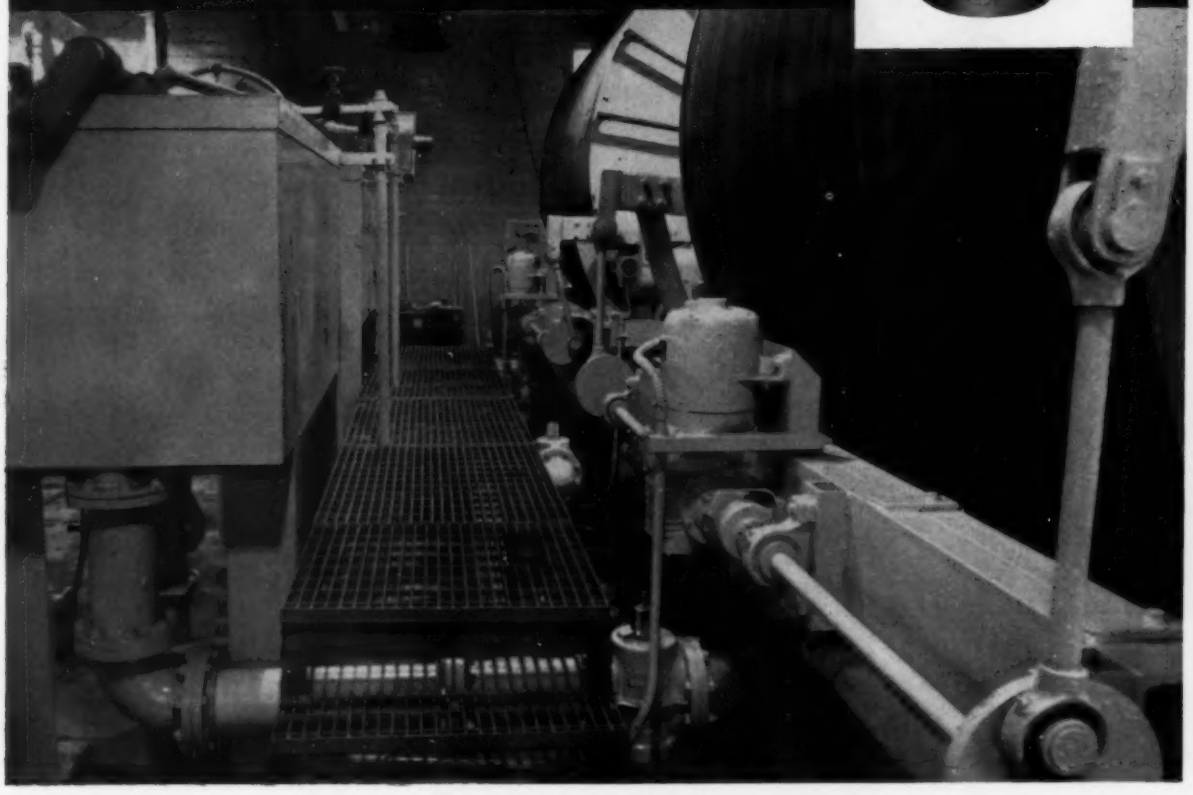
HOMESTEAD *Lubricated* PLUG VALVES



Homestead Lubricated Plug Valves on lines handling digested sludge to vacuum filters.

Sewage plants that use 100% Pipe-Area Homestead Lubricated Plug Valves, have taken a big and important step toward assuring low operating costs. Pumps are not overworked on restricted lines. Maintenance costs are kept low by Homestead's controlled high pressure lubrication system, which protects all sealing areas against corrosion and automatically frees the plug for instant turning. Control is quick and efficient. A quarter-turn of the lever fully opens or closes the valve; thus simple low cost units may be used for power operation or remote control.

Reference Books 39-5 and 39-5A give full information about Homestead Lubricated Plug Valves—sizes, types, metals, lubricants, and how to specify or order. You may have copies without obligation; so why not mail the coupon now?

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Mr. City Engineer!

What is Your City Going to Do for Water 10 Years From Now?

Take a good long look at the table below. It's the estimate of future water use in the U.S.A., according to the United States Department of Commerce, Water and Sewerage Industry and Utilities Division:

TABLE 1: ESTIMATED UNITED STATES WATER USE

(BILLIONS OF GALLONS DAILY AVERAGE)

		Public	Self Supplied Use			
Year	*Irrigation*	*Water Supplies*	*Domestic*	*Industrial and Misc.*	*Steam Electric Power*	*Total Water Use*
1900	20.2	3.0	2.0	10.0	5.0	40.2
1910	39.0	4.7	2.2	14.0	6.5	66.4
1920	55.9	6.0	2.4	18.0	10.0	92.3
1930	60.2	8.0	2.9	21.0	18.4	110.5
1940	71.0	10.1	3.1	29.0	22.2	135.4
1950	100.0	14.1	4.6	46.0	38.4	203.1
1955	119.8	17.0	5.4	60.0	59.8	262.0
1960	134.9	22.0	6.0	71.9	77.6	312.4
1965	148.1	25.0	6.5	87.7	92.2	359.5
1970	159.0	27.8	6.9	103.0	107.8	404.5
1975	169.7	29.8	7.2	115.4	131.0	453.1

When your City makes its plans to enlarge its water system—as so many are doing—be sure to choose—

Permanent **CAST IRON PIPE**

No other pipe has ever matched its record of longevity, durability, dependability, low maintenance cost and long run economy. That's why it is rightly known as **"America's No. 1 Tax Saver."**

Our Company does not manufacture Cast Iron Pipe but supplies many of the nation's leading foundries with quality pig iron from which quality pipe is made.

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Only Mueller Gate Valves have the exclusive "four-point contact" disc wedging mechanism. Closing pressure is equally distributed to four separate points near the outer edge of each disc. Shut-offs are made faster, easier and tighter - without disc deflection or sliding contact. See your Mueller Representative, Catalog W-96 or write today for full details on the complete line of Mueller Gate Valves.

Iron Body, Bronze Mounted
Double Disc, Parallel Seat Type
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2" Operating Nut or Handwheel
Hub, Flanged, Spigot, Universal, Screwed, Mechanical Joint or "Ring-Tite" Ends
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"O" Ring Conversion Kits now available for all Mueller Non-Rising Stem Gate Valves up to 12", which were originally equipped with conventional packing.

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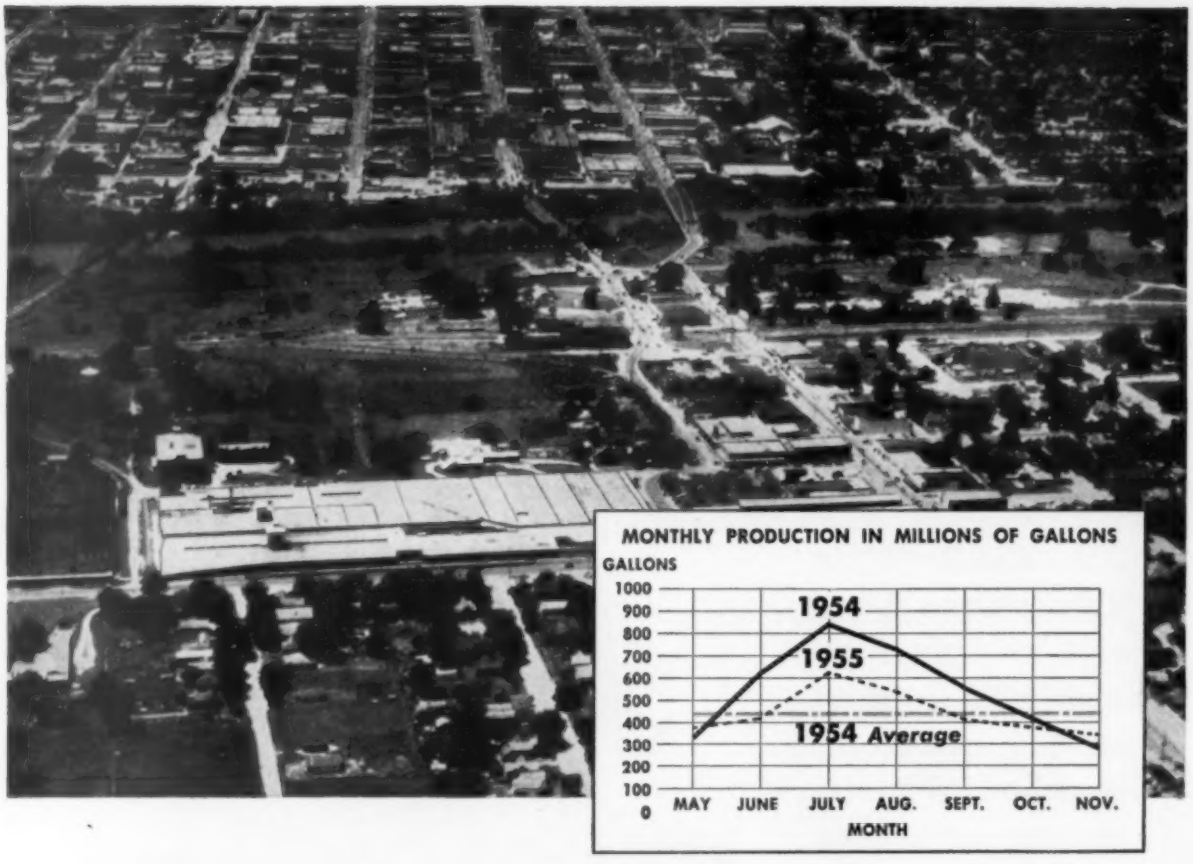

ALOXITE® underdrains handle double load without difficulty in Waco, Texas

Peak loads during dry spells really tax Waco's water system. At these times the filters handle up to 4 GPM per sq. ft.

In July, 1954, for instance, water consumption jumped from the year's average of 448 MG to 842 MG per month. Despite this 87% increase in demand there were no operating difficulties.

Much credit for being able to meet such abnormal requirements is given to the ALOXITE® aluminum oxide porous underdrains. These were installed in new filters in 1951.

Since then, several related events have occurred. Population has grown from 84,000 to 110,000. Water consumption has reached 14.7 MGD from 10.0 MGD. And mudballs and upset beds are but a memory for the plant operators. Uniform, ample backwashing is now an established and vital phase of operation.

The City of Waco is to be commended for its foresight in providing equipment to assure adequate water supply, even during peak demand periods. Mr. Curtis Harlin is Superintendent of Water and Sewage, while Mr. W. J. Biederman is Plant Superintendent. J. J. Rady Company, Fort Worth, Texas were Consulting Engineers.

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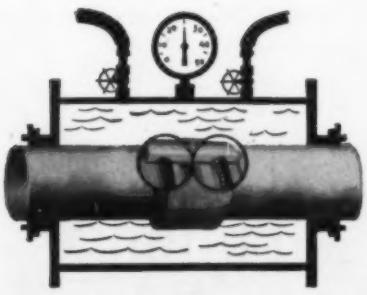

Infiltration of external fluids and entrance of roots are eliminated by "K&M" FLUID-TITE Coupling installed with "K&M" Asbestos-Cement Sewer Pipe. Here, external water under 25-psi pressure (far beyond ordinary field conditions) has no effect on the FLUID-TITE joint.

For gravity sewer systems, "K&M" Asbestos-Cement non-pressure Pipe is the modern answer to the need for low-cost, permanent water-tight connections. The exclusive FLUID-TITE® Coupling makes installation quick and easy—and permanent.

No special equipment; little skill needed. Just two easy steps: 1. Lubricate rubber rings; 2. Slide pipe into coupling. The FLUID-TITE principle keeps piped fluids in, keeps external fluids and roots out, and allows pipelaying that keeps up with the trench digger in speed. Installation costs go down when you specify the *modern* pipe and coupling system . . . "K&M."

Learn the advantages of the *modern* pipe from the K&M distributor. Or write to us for complete information.

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For more than 50 years, Neptune has built fine meters designed to earn more and cost less. Many 50-year-old Tridents are still in service . . . perhaps in your own community . . . living proof that the Tridents you buy today will be a credit to your water system for many long years to come.

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WATER & SEWAGE WORKS

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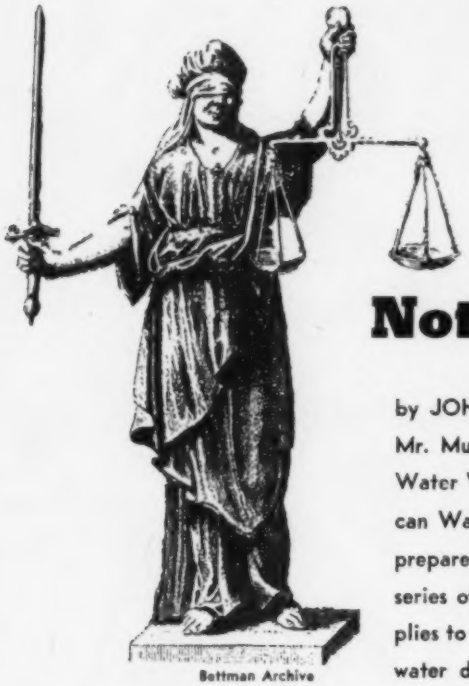

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Notes on Water Works Law

by JOHN H. MURDOCH, JR.

Mr. Murdoch, former Vice-President of American Water Works Co., Inc., and Chief Counsel of American Water Works Service Co., Philadelphia, Pa., has prepared exclusively for *Water & Sewage Works this* series of articles discussing water works law as it applies to source of supply, water quality and treatment, water distribution—its use and abuse.

Diven Medalist and Hon. Member AWWA

12th and Final Installment

How the Courts Consider Pipe Line Breaks *

IN THIS INSTALLMENT of "Notes on Water Works Law" will be presented a brief statement of the law in the United States on the liability of public water supply agencies for damages occasioned by pipe line breaks.

Since federal or constitutional questions are not involved, the law on the liability for damages created by water pipe-line breaks is law in the several States, not Federal law. It is law founded upon and contained in decisions of individual state courts rather than the Federal courts. Although variations are to be expected, there is enough agreement recorded to make possible the brief summary statement that is here attempted.

Publicity and Privately Owned Systems Subject to Liability Alike

On one point there appears to be uniformity of opinion. As to liability for damages for pipe line breaks, there is *no* distinction between publicly and privately owned water supply systems. Privately owned water systems are, of course, business enterprises and as such are responsible for the actions or neglect of their officers or employees in the performance of their duties. When a municipality or other governmental body, except a state or the United States, undertakes to supply water to the public for commercial, domestic and industrial purposes, and to charge for such service, the courts hold that it is engaged in performing a business function, and to be acting in its proprietory capacity and not in its governmental capacity, at least so far as to make itself liable for line break damages. It is beside the point here but fire service, as discussed in the 11th article of this series in the May 1957 issue of this magazine, is held to be a governmental

Ed. Note: Mr. Murdoch, having reached the mandatory retirement age under the retirement plan of the American Water Works Co., has been retired. However, he continues active in the fields of water works law and water works management.

*This installment is based on a paper of the same title presented before the Am. Water Works Assn. in Atlantic City, May 13, 1957. It is here printed by permission of the Association.

function. It will be remembered, too, that the United States Supreme Court a number of years ago held that W. W. Brush was not subject to federal tax on his salary as chief engineer of the New York City water system because that system was performing a governmental function. In spite of these quirks of the law the fact is that as far as water line break damage is concerned the courts believe that there can be no distinction between publicly and privately owned water supply system.

Three Lines of Cases

There appear to be three lines of cases in which the state courts have dealt with claims for damages caused by line breaks. At this point these three lines will be designated and described only to the extent required to indicate the essential distinctions between them. Later each line will be explained in a little more detail after certain definitions, essential to an understanding of the various courts' views, have been stated.

In the first line of cases the courts of the great majority of our states hold that a public water supply agency is liable in damages for injuries of loss caused by water escaping from pipe line breaks *only* if it be proved that negligence chargeable to the water supply agency was the proximate cause of the loss. The point in this majority line of cases is that the existence of negligence must be proved.

The second line of cases might properly be disignated as a variant from the first. It may be called the *Res Ipsa Loquitur* line. Here again, proof of negligence is an essential element. However, in this line the courts have held that the fact that the pipe line was in the exclusive possession and control of the defendant agency and that it had exclusive knowledge of the care exercised in the line's installation and operation, and that it appears that the accident would not ordinarily occur without negligence, there is sufficient inference of negligence to shift the burden of explanation to the defendant and to require that the case be submitted to the jury.

The third line of cases follows an English case of the 1860's known as Rylands v. Fletcher. This case did not involve a pipe line break but rather the flooding of a mine with water escaping from a water supply reservoir into an abandoned mine directly under the reservoir. It was the excessive induced drainage from the abandoned mine into the adjacent working mine wherein damage was done. The English court held that there was no negligence involved. They held, however, that when one maintains on his own property a thing which would cause injury to others if it escaped is liable if the escape occurs even though no apparent negligence exists. This doctrine has not been widely adopted in the United States but the courts of Minnesota have adopted it as applicable to water pipe line breaks.

Definitions Essential to an Understanding of Court Rulings on Pipe Line Breaks

Negligence is the failure to observe for the protection of the interests of others, that degree of care, precaution, and diligence which are demanded by the circumstances, whereby others suffer injury. Otherwise stated, *negligence* is conduct which falls below the standard established by law for the protection of others against unreasonable risk of harm.

Standard of Conduct (as established by law) is that of a reasonable man under like circumstances.

Reasonable Man, in water works cases, would be a well trained and proficient water works man.

Unreasonable Risk is one in which the dangers involved outweigh the value of the conduct.

Thus there is negligence in pipe line break cases if servants, agents of officers of the water supply agency or utility do not act as well trained water works men would act under like circumstances and where their conduct creates risks of harm to others which outweigh in value the social advantage of having a water pipe line in operation in the particular location.

Majority Rule Line of Cases— Negligence Must be Proved

The courts of the states which follow the rule in pipe line break cases that the public water supply agency can be held liable for damages only when the claimant proves negligence have had before them a very great variety of factual situations. It seems inappropriate in such a presentation as this to cite cases and to set forth the facts which lead to the court decisions. Each water works man in considering claims for damages in instances of line break and in determining what he should do in the future to protect his agency against claims must weigh the conduct involved by comparing the conduct with that of a well trained water works man. Unless the conduct comes up to such a "standard" there is negligence; and, liability for damage claims.

A well trained water works man chooses the weight or class of pipe designed to meet the internal pressures and external traffic loads to be anticipated. It would probably be held by the courts to be negligence if too light weight pipe were used or if pressures were raised in the area of the pipe break to a point beyond the safe capacity of the installed pipe. It would probably be considered negligence if pipe were installed without adequate safety factor provision for water hammer or surge.

A well trained water works man will install pipe lines with safe, adequate support and in a way to have the pipe cushioned and protected against shocks and strains. The courts have found negligence when it was determined that these precautions had not been taken.

A well trained water works man will be suspicious about unexplained running water, sinking street surfaces along routes of pipe lines and other indications of joint leakage or possible broken mains. Failure to follow up with adequate investigations when such indications develop has been considered negligence.

When a break occurs, the well trained water works man does all in his power to mitigate damage. The courts have often absolved the water agency of liability for the break but held it liable for damages because of delay in shutting off the water.

The Hazards of Inspection of Customer's Premises

A well trained water works man does, in his water works occupation, all that is required of him by law or by the rules of his agency for the protection of his customers or the public. For that reason most of us seriously object to the imposition on, or assumption by, water works men of duties such as inspection of customers' premises, which water works employees are usually not competent to make. As an illustration it is suggested that a water supply agency should have the right by ordinance, system rule, or public utility commission rule to shut off water service to a customer, where there has been brought to the attention of the water supply agency conditions showing that the customer is employing facilities in a way likely to jeopardize other customers or the public system. Evidences of dangerous water hammer or surges of a nature and frequency to indicate improper

interior conditions on a customer's premises would be an instance. The agency or water utility should resist having imposed on it responsibility for inspection of customer premises and the giving of advice. If such responsibility were imposed or assumed and not competently performed, the courts might well hold there was negligence.

The "Res Ipsa Loquitur" Line

The law Latin phrase *Res Ipsa Loquitur* may be translated as "The thing speaks for itself." As was pointed out earlier, when the doctrine is called into play in a proper case the plaintiff is held to have established an inference of negligence and to have the right to have the case go to the jury. There can, however, be no recovery unless negligence of the water supply agency be proven to be the proximate cause of the injury. There is no presumption of negligence but merely an inference. The courts of New York State have given more weight to the doctrine than those of any other state and, as pointed out in the case of Foltis v. New York City, 287 N. Y. 108, have often misunderstood it and misapplied it. Unfortunately, courts and lawyers in other states have been led astray by reading earlier New York cases and overlooking the fact that the Foltis decision, in effect, makes unsound much of the language in the earlier cases.

Rylands v. Fletcher Line

The courts of Minnesota appear to have been the only ones which have adopted the doctrine of this case as applied to pipe line breaks and to have held that a water supply agency must at its peril prevent breaks. In effect this means that in spite of the social value of water mains and of the fact that the injured party benefits from the community life made possible by the water mains, the placing and maintaining of water under pressure in the streets creates such hazards that the water supply agency must answer in damages if water escapes and causes injury, though there be no negligence.

The English case has been briefly stated perviously and that statement will not be repeated. On the reported facts it is probable that a modern court in any or our states would have found negligence. The English courts at the time ruled out negligence and fixed liability even though the defendant was found to be without fault. It is almost certain that the court was still thinking in the way common in early English courts where fault was not considered essential to liability for damages. For illustration if a man be walking and be attacked by footpads and defend himself with his cane, he would be liable for damages to an innocent person at his back, struck by the cane when drawn back to strikes at the attackers. Here the English courts held there was liability for damages without fault. Our courts do not like such results and the Ryland v. Fletcher line of cases seem to be limited to Minnesota.

The Seattle Case

A case is now pending in the Supreme Court of the State of Washington which is of general interest. The courts of Washington have been in the habit of following the majority rule—negligence proof required—in passing on pipe line break cases. The water department of the City of Seattle had such a break and properties were damaged. The cases were tried in the lower court by a judge without a jury. The judge held the city free of negligence but held the city liable without fault. In doing so the judge followed the Rylands v. Fletcher line of cases in spite of the precedents to the contrary in his state and also appears to have given weight to *Res Ipsa Loquitur* although he had found, as a fact, that there was no negligence.

Conclusion

When the state courts in the United States look at pipe line breaks, most of them look at the value of water service to the community and to the rarity of breaks when considered in relation to the exposures to risk, considering the lengths of pipe and the constant time element involved, and hold that liability will attach only on proof of negligence. When water works men perform their duties as well trained water works men would, the agency will not be liable for damages due to breaks.

L. R. Howson Nominated for President of ASCE

Louis R. Howson, Consulting Engineer of the firm, Alvord, Burdick and Howson, has been nominated for the presidency of the American Society of Civil Engineers. The nomination, which is tantamount to

election took place at the Buffalo, N. Y. meeting of the ASCE. He will take office at the Society's annual meeting in New York in October.

Mr. Howson who has written many article for *Water & Sewage Works* has been active in the field of sanitary engineering ever since his graduation from the University of Wisconsin, when he joined the firm of which he is now the senior partner. He is a past president of the AWWA, having served in that capacity in 1942. He is also an Honorary Member of AWWA, from which he has received the Fuller Award, the Goodell Prize and the Diven Medal.

In addition to his many activities in the Amer. Water Works Assn., he has also been active in ASCE, having been vice president in 1955 and 1956 and a director from 1949 to 1953.

Mr. Howson is noted for his clear and forceful writings, particularly on the subject of water rates and revenues. Among his numerous outstanding consulting assignments have been the Milwaukee Sewerage Commission, the Toronto, Ont. Metropolitan Commission, The Chicago Water Diversion Case before the U. S. Supreme Court and New York City, Chicago and the Atomic Energy Commision on water supply problems.

W. H. Corddry New President of Gannett, Fleming, Corddry & Carpenter

At a recent meeting of the Board of Directors of Gannett Fleming Corddry and Carpenter, Inc., consulting engineers of Harrisburg, Pa., W. H. Corddry was elected president of the corporation, succeeding Farley Gannett who became chairman of the Board of Directors.

At the same time S. W. Fleming, Jr. was named Vice-Chairman of the Board and Treasurer of the corporation and J. D. Carpenter became Senior Vice President and Secretary of the corporation.

The company also announced the formation of an associated partnership to handle various consulting engineering assignments, the partners being W. H. Corddry, J. D. Carpenter, J. R. Dietz and R. W. Foster. Messrs. Dietz and Foster are also officers of the corporation.

Something New —
The Magnetic Flow Meter

For the measurement of liquid flow

by RUSSELL H. BABCOCK

Mr. Babcock is Assistant Manager of the Utilities Industrial Division of the Foxboro Co., Foxboro, Mass. In this article, he discusses the history and operating principles of a new flow measuring device.

SINCE THE EARLIEST days of water works practice, there has been a continuing effort to improve existing methods of measurement and to develop new instruments for more accurate appraisal of system variables. One of the latest developments in this search for better measurement is the magnetic flow meter. Because flow is one of the principal variables on which the operation of installations depends, consideration of this new device is both timely and applicable.

The principle of operation of the magnetic flow meter is essentially the principle of electromagnetic induction first proposed by Physicist Michael Faraday in the early part of the nineteenth century.

History

In 1839, Faraday tried to measure the flow of the Thames River by applying his theory of electromagnetic induction. He placed two copper wires in the Thames River and, using the earth's magnetic field, attempted to measure the flow of river water. Because his voltmeter was somewhat less sensitive that he anticipated, the attempt did not succeed. Faraday reported in his notes as follows, "I constantly obtained deflections of the galvanometer but they were very irregular and were in succession referred to other causes than that sought for. The different condition of the water as to purity on the two sides of the river; the difference in temperature; slight differences in the plates, in the solder used, in the more or less perfect contact made by twisting or otherwise; all produced effects in turn; and though I experimented on the water passing through the middle arches only; used platinum plates instead of copper; and took every other precaution, I could not after three days obtain any satisfactory results."

No further work of major importance was done on electromagnetic metering of flow until Smith and Sleppian developed their magnetic ship's log, securing a patent on the device in 1917. At the present time, the United States Navy is engaged in building a ship's log based upon this principle.

Since that time, an impressive number of separate investigations have been carried out but in no instance was complete success achieved until the development of the Foxboro Magnetic Flow Meter. Earlier attempts failed to solve the problem of providing a high degree of accuracy, a wide range of meter sizes, and insensitivity to such effects as temperature and conductivity.

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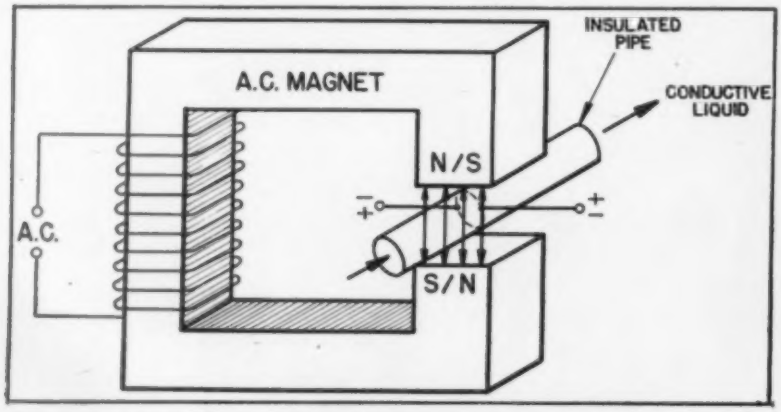

Fig. 1.—PRINCIPLE of the magnetic flow meter.

Principle of Magnetic Flow Meter

To understand how the magnetic flow meter meets the requirements of flow measurement, it is only necessary to review Faraday's law of electromagnetic induction. In general, this law states that if a magnetic field is generated in one direction and a conductor is moved at right angles to the field, a voltage will be generated which is directly proportional to the speed of the conductor and the strength of the field. In terms of instrument design, Fig. 1 shows that if an electromagnet generates a magnetic field of constant strength at right angles through a non-magnetic flow tube and a conductive liquid is passed through the tube, a voltage will be generated which is directly proportional to the rate of flow of the liquid. In direct contact with the liquid are two electrodes set into the tube diametrically opposite each other and insulated from the tube. To avoid shorting out the voltage, the tube is lined with an insulating material. The voltage signal from these electrodes is recorded in desired units of flow on an AC millivolt meter of special design. The equation of the magnetic flow meter is as follows:

$$E = K \frac{VHd}{A}$$

where:

- E = generated EMF, measured at the electrodes
- K = a constant for units of measurement
- V = volume of liquid per unit of time
- H = field strength between electrodes
- d = distance between electrodes
- A = cross sectional area inside pipe

The equation shows that the milivoltage output is equal to the product

of the constant for the unit of measurement, the volume per unit of time, the field strength, and the distance between electrodes, divided by the cross-sectional area of the pipe. This equation is entirely linear and includes no square root function to complicate recording.

Adaptability of the Meter

In evaluating the adaptability of the meter to typical water distribution and treatment applications, the question of turbulence or variation of the flow profile naturally arises. The magnetic flow meter reading is the average of the incremental velocities occurring within the pipe section between the two electrodes. Weigh tank tests have proved that here is no appreciable change in measurement accuracy between turbulent and laminar flow. The results of a test conducted by the Alden Hydraulic Laboratory on an 8-in. magnetic flow meter are shown in Fig. 2. (A crossection of the magnetic flow meter is shown in Fig. 3.) The deviations from the normal calibration curve occurred when a pipe elbow was installed directly upstream and when a swirl was artificially induced. In neither instance was any appreciable error observed.

Only when a conductor moves through a magnetic field will there be a measureable EMF generated across the electrodes. Therefore, in electromagnetic metering the fluid to be measured must be conductive. What constitutes a conductive fluid for purposes of electromagnetic flow measurement? The fluids encountered in water works applications normally have a conductivity greater than 100 micromhos. This is far above the minimum conductivity of 50 micromhos required for an 8-in. magnetic flow meter using 300 feet of lead wire between transmitter and receiver. It has been demonstrated that at values below 50 micromhos, the only undesirable effect is a wandering zero when there is no flow in the line. When flow resumes the meter reads accurately.

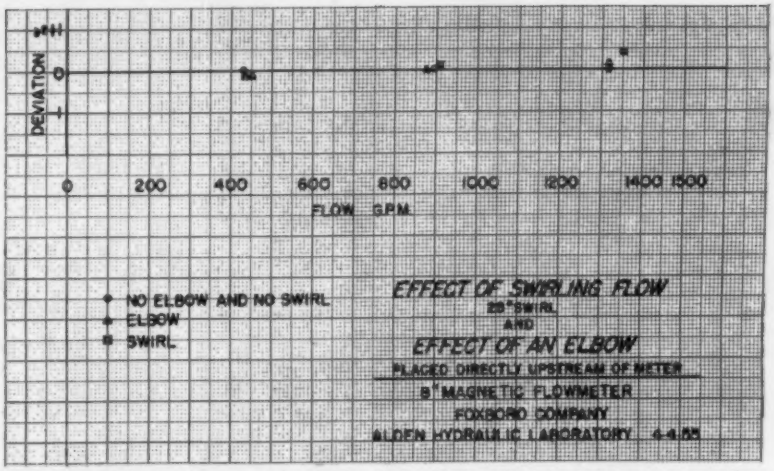

Fig. 2.—RESULTS of test conducted by Alden Hydraulic Laboratory on magnetic flow meter.

Since the magnetic flow meter is not subject to the effects of upstreams disturbances, it is possible to predict in advance of installation what the accuracy of the meter will be. The magnetic flow meter, including the transmitter and the recorder, has an over-all accuracy of 1 per cent. It is not necessary to add a safety factor to allow for possible errors from an improperly installed primary device, as done in calculating inferential meter accuracies. Regardless of the manner of installation, the accuracy of the magnetic meter remains unchanged at 1 per cent.

Application Advantages

To water works engineers, the magnetic flow meter has certain obvious application advantages. It adds no more loss of head to a hydraulic system than a straight pipe of the same length and size. Since it does not require a straight meter run, installation costs are apt to be much less than for other primary devices.

A 20-in. magnetic flow meter has been in service at the Chicago Southwest District Filtration Plant since the summer of 1956. John Baylis, Engr. of Water Purification, Chicago has published an article on this installation in "PURE WATER," a house organ of the Chicago Water Department. In it, he expresses satisfaction with the meter and reports that its high degree of sensitivity has enabled him to observe effects of line noise produced by the recovery cone of a Venturi tube down-stream (Fig. 4). In this instance, the meter is installed on the end of an elbow and directly upstream of a hydraulic rate of flow controller.

Other Applications

A number of meter installations have been made in the process industries; particularly, in the field of pulp and paper manufacture. The meter has obvious advantages for handling fluids containing high percentages of solids because there is no need for purge systems and there are no pockets or crevices in the flow tube where material can accumulate.

The sewage treatment field is also starting to use the magnetic flow meter. Many engineers consider it very nearly the ideal metering device for sludges.

The magnetic flow meter, based on principles of the earliest laws of electricity, is applicable to flow measuring problems that have plagued water works engineers for years. It gives promise to lead to more efficient plant operation and greater design flexibililty.

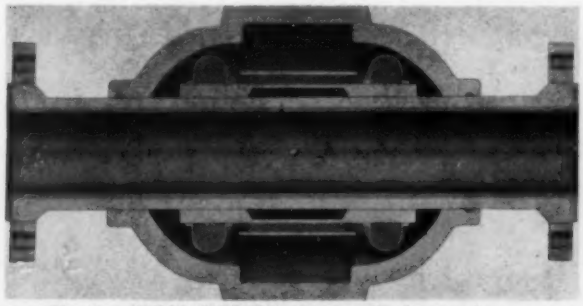

Fig. 3.—CROSS SECTION of magnetic flow meter.

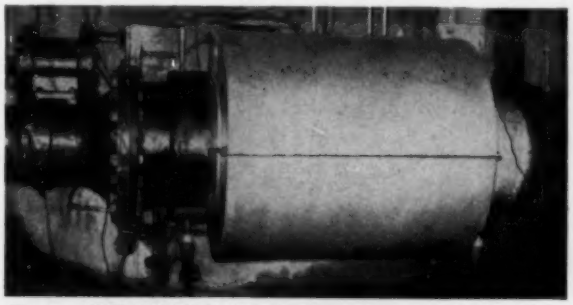

Fig. 4.—EXPERIMENTAL installation of magnetic flow meter.

The Magnetic Flow Meter At Medfield, Mass.

by EDWIN B. COBB

Mr. Cobb is a partner in the consulting engineering Firm of Metcalf & Eddy in Boston, Mass. His article on this new type of flow meter and its application to two way measurement will be of interest to many water works men.

THE FIRST USE of a magnetic meter to measure two-way flow of water in a public water system was, as far as can be learned, at Medfield, Mass. A public water supply is not generally considered a good place to experiment with newly developed devices, but in this case the convenience and saving in cost obtained by use of such a meter justified its selection.

Medfield is a predominately residential town located about 17 miles southwest from downtown Boston. The 1950 population of the town was reported as 4,549, including 2,136 inmates of the Medfield State Hospital. The 1955 state census gave the town a population of 5,293.

From 1932 to 1956 the town purchased water under contract from the Medfield State Hospital. In 1953 the supply to the state hospital was found to be inadequate to meet the future requirements of both the town and the hospital, and an additional source of supply was considered. The hospital authorities decided that an additional supply of 1.0-mgd. capacity, estimated to cost $90,000, would be required, and proposed to pass this entire cost on to the town through increased water rates.

The proposed increased rates would have made the cost of the water delivered at service pressure about $350 per million gallons. The town officials considered this a high price to pay for water and decided to investigate the possibility of an independent supply for the town.

The writer's firm was engaged to study the situation and to make a recommendation as to the most economical solution. After a careful investigation of the problem, the construction of a groundwater supply by the town was recommended. Amortization of the cost of developing the supply, plus the cost of pumping the water, was estimated to amount to about $165 per million gallons, or about only one-half the proposed cost of water purchased from the hospital. This recommendation was adopted, and a gravel-packed well with pumping station and force main was constructed near the Charles River.

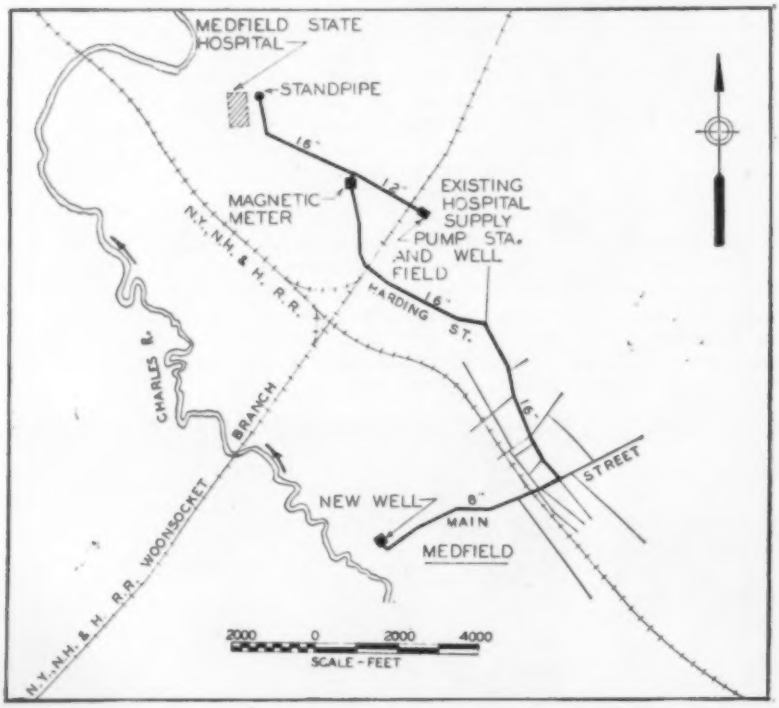

Fig. 1.—WATER SYSTEM of Town of Medfield, Mass. and Medfield State Hospital.

Benefits Both

Under usual procedure, the town also would have constructed its own standpipe to provide a supply to supplement the pumpage from the well during peak demands on the system. The existing standpipe at the state hospital however, is of generous proportions and the hospital authorities were quite willing for the town to continue to share its use. In addition the continued interconnection of the systems would give each an auxiliary source of water for use in an emergency. Successful operation of the arrangement, however, required the provision at the point of inter-connection of a meter which could measure the flow in two directions.

The general arrangement of the water systems of the town and the state hospital is shown in Fig. 1. The state hospital obtains its supply from a well field on the southerly side of

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Fig. 2.—MAGNETIC flow meter in vault.

Fig. 3.—SECONDARY instrument mounting.

the Woonsocket Branch of the New Haven Railroad, about 1,500 ft east of Harding Street. This supply consists of 63 2½-in. tubular wells, together with a pumping station equipped with two centrifugal pumps, each rated at 900 gpm. Water is pumped through a 12-in. main as far as Harding Street, where it is discharged into a 16-in. main which runs northwesterly to a standpipe at the hospital and southeasterly to the center of Medfield. A meter vault, now equipped with a magnetic meter, is provided in the 16-in. main leading to the town.

The new town well has a rated capacity of about 290 gpm and discharges to an 8-in. main in Main Street, which connects with the 16-in. main at the center of the town. A Dall flow tube at the pumping station provides a means of measuring the pumpage from the well.

According to the consultant's report submitted in December 1953, the water consumption by the town for the 12-month period ending October 31, 1953, was as follows:

Yearly daily average	145,000 gpd
Max. monthly daily avg.	208,000 gpd
Maximum day	318,000 gpd

It was estimated that by 1980 the water consumption would increase to the following amounts:

Average daily use	189,000 gpd
Maximum one-day use	378,000 gpd

Unprecedented growth in the town since this report was submitted leads to a belief that these estimates may be exceeded somewhat previous to 1980.

To comply with the standards of the National Board of Fire Underwriters, the town should be able to obtain a fire flow of 2,000 gpm at the central district for a period of 8 hours on the day of maximum consumption. Under the conditions estimated for 1980, to meet these requirements would require about 960,000 gallons for the fire flow plus 126,000 gallons for consumption, or a total of 1,086,000 gallons in 8 hours. The 1,680,000-gal. capacity of the existing standpipe is more than adequate to supply this quantity of water.

In proposing the joint use of the standpipe, it was suggested that each system attempt to match its consumption with its pumping and any over- or under-run adjusted periodically by decreasing or increasing the respective pumping periods, as applicable. Such an arrangement has been in force since early in the summer of 1956; it appears to be working very well. Recently, the Medfield superintendent reported that he had about 1,000,000 gallons of surplus pumpage in the bank, and in view of his limited pumping capacity (290 gpm) he felt this placed him in a favorable position for maintaining good relationship with the hospital authorities.

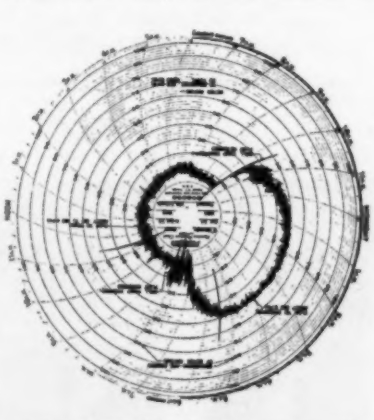


Fig. 4.—TYPICAL CHART from magnetic meter.

Meter Vault Governed

Initial consideration for metering was a system using two displacement-type water meters, one for each direction of flow, together with suitable check valves and bypass. The greatest concern was the measurement of the flow from the hospital system into the town system. For reasons of economy and accuracy of measurement, it was desired to use as small a meter as possible for this service, at the same time avoiding undue restriction through the meter when flows in excess of 2,000 gpm might be required for fighting fires.

Studies indicated that the existing meter vault was too small to accommodate suitable displacement-type meters. New vaults would be necessary, together with same awkward connections to the 16-in. main. A further drawback would be the inconvenience of opening and entering a vault in the street at frequent intervals to read meters of this type. The estimated cost of such an installation was about $9,300.

Magnetic Meter Selected

About this time the author became acquainted with the magnetic flow meter, as manufactured by the Fox-

boro Co. Upon investigation, it was learned that such a meter could also be made to measure flow in both directions, through provision of suitable relays in the secondary instrument. A 6-in. meter was found to be of proper size and this meter, having a smooth flow tube of 6-in. diameter, would offer but little resistance to high rates of flow.

Most helpful of all, it was found that this meter, with but minor modifications in piping and with no interruption of service to the town, could be installed in the existing meter vault. Being of the electrical type, the secondary instrument was readily mounted on the roadside in a weatherproof housing, thus eliminating the necessity of frequent opening of the meter vault. The cost of the installation, exclusive of engineering, was $5,132.

The meter was specified to be of 6-in. size, rated for 2,000 gpm in one direction and 500 gpm in the other. The secondary instrument has two totalizing dial counters, reading directly in gallons, one to record the total flow in each direction. Ordinary 110-volt, single-phase, electric current was sufficient to furnish power to the unit.

The meter and appurtenances were furnished and installed under contract by R. H. White Construction Co., Inc., of Auburn, Mass. A view of the meter as installed in the vault is shown in Fig. 2. The secondary instrument mounting and housing at roadside is shown in Fig. 3. The slight amount of heat generated by the power dissipated in the meter appears to protect it from dampness.

The standard type secondary instrument furnished by the manufacturer includes a mounting for a recording chart. A special instrument which omitted that chart would have been more expensive; therefore, a standard type unit was accepted. As a mater of interest, charts have been placed on the recorder from time to time, to observe the pattern of flow variation. A typical chart, which recorded the flow from 8 am October 4, to 8 am, October 5, 1956, is shown in Fig. 4.

Had the recorder been specified with the equipment, the manufacturer stated that a different type of unit (with surge dampeners and other devices) would have been provided, to give a much more readable record. In spite of the shortcomings of the charts, however, considerable information about consumption characteristics of the town system can be obtained, when desired, from occasional charts on the present recorder.

How Meter Is Read

Because the meter is rated differently for each direction of flow, the chart graduations read in percentage of rated capacity. Thus, the portion of the record along the 50 graduation would be interpreted to be 50 percent of 500 gpm, or 250 gpm, and indicates that this flow is going into the hospital system. The difference of this reading and the 290 gpm discharge of the well pump, or 40 gpm, indicates the rate of consumption by the town.

Similarly, the portion of the curve along the 6 graduation indicates that, with the well pump shut off, 6 percent of 2,000 gpm, or about 120, was flowing from the hospital system into the town system.

To determine when to change scales, the long, curved lines normal to the graduations are picked out. When there is a reversal of flow, the indicator drops to zero and then goes to the other range. This is best illustrated by the line at 10:30 pm. Just previous to this time, the well pump was not in operation and the flow was to the town. At 10:30 the pump was started and the direction of flow reversed. The meter continued to indicate in this range until about 8:30 the next morning, when the pump was shut off.

Between 5:30 and 7am, the consumption by the town increased to a point where it was taken nearly the entire pumpage from the well. Between 7 and 8 am, the rate of consumption exceeded the pumpage from time to time, and there were several reversals of flow.

In the area of rapid reversal of flow, the chart is not of too great value, as it is almost impossible to determine which scale to read. After the pump was shut down at 8:30, the flow settled down to one direction and varied between 120 and 220 gpm, with a peak flow to town of about 240 gpm around 7 pm.

The records on the totalizer are reported to be quite precise, as the meter is very sensitive to small flows and the reversing relays in the secondary instrument are capable of operating at relatively high speeds.

Inspection and Test

Because the magnetic meter is a fairly new development, together with the possibility of failure in the electrical appurtenances, the manufacturer has been placed under contract to inspect and test the meter quarterly for a period of five years. A simple electrical measurement permits the inspector to check the adjustment of the secondary instrument precisely. The meter was placed in service May 3, 1956. To date there has been but one failure of the meter reported, apparently due to the failure of a relay. The relay has been redesigned and replaced by the manufacturer.

Use of the magnetic meter at Medfield represents a special application, to which it appears well suited. Its installation afforded definite savings in cost over a more conventional arrangement, and permits more convenient access for reading and checking. Experience to date indicates that it is as reliable as other commercial types of flow meters of similar capacity.

Dr. Imhoff and H. S. Morse ASCE Honorary Members

Among the four members of ASCE elevated to Honorary Membership, two are well known to readers of *Water & Sewage Works*. Dr. Karl Imhoff of Germany and Howard S. Morse of Indianapolis, Ind. Also honored were Prof. W. C. Huntington, recently retired head of the Civil Engineering Dept. of the University of Illinois and Perez Castro a railroad engineer of Mexico City, Mex.

Dr. Imhoff is world renowned as a sanitary engineer, not only for the design of the sewage and sludge tank which bears his name, but also for his many books and articles on sewage treatment. Since the war he has been a consultant in Essen, Germany. About a year ago he was honored with a special plaque by the Federation of Sew. and Ind. Wastes Assns.

Karl Imhoff

H. S. Morse

Mr. Morse has been connected with the Indianapolis Water Co. since 1925, having served as manager, vice president, president, and now chairman of the board. He has been active in, and is a Fuller Awardee and Honorary Member of AWWA.

Advantages and Limitations of
The Membrane Filter Procedure

by H. F. CLARK, P. W. KABLER and E. E. GELDREICH
Microbiology, Water Supply, and Water Pollution Control Program, respectively, Robert A. Taft Sanitary Engineering Center, U. S. Public Health Service, Cincinnati, Ohio

THE MEMBRANE FILTER procedure offers a rapid and reproducible method for the estimation of coliforms in samples of most treated and untreated waters.

Advantages of this procedure are availability of data within less than 24 hours, elimination of some of the errors of the multiple-tube method, and reductions of space, material and equipment with approximately one-half the labor of technical work and preparation.

The filtration procedure also has its limitations, which require that a certain degree of judgment must be used in its application to the examination of samples. Samples where the filtration procedure cannot be used are generally easy to recognize. Typical examples are the presence of gelatinous flocs, presence of algae in quantity, or samples with high non-coliform density and very few or no coliforms present. These limitations can be observed during the test, making it easy to eliminate unreliable data in the filter method. Errors that occur in the multiple-tube procedure are difficult to recognize and time consuming to demonstrate.

During World War II, German military and civilian authorities used a membrane filter for water examinations following the destruction of laboratory facilities by strategic bombing. With the release of the membrane filter for civilian use after the war, many manufacturing improvements were made. The filters are currently being manufactured in the United States, Germany, England, and perhaps in other countries.

What the Filter Is

The membrane filter is a thin wafer composed of esters of cellulose with an effective pore diameter of 0.5 micron and consisting of approximately 80 percent voids. The conical pore has its axis perpendicular to the flat surface and its narrow diameter at the top surface. Membranes may be obtained in a variety of sizes to fit any filtering apparatus, but those used in this country are usually 47 mm or, rarely, 50 mm in diameter.

For convenience in counting colonies, the membrane is usually grid printed, with the size and number of squares being a matter of individual preference or manufacturing policy. In addition to the membranes and absorbent pads, a filtering apparatus and liquid media designed for membrane filter techniques are the only special equipment needed which will not be found in the average bacteriological laboratory concerned with the examination of water samples.

Methods for filter tests are easily mastered and can be used routinely in the laboratory, but recommended procedures must be carefully followed for best results. The current status of the tests in the individual location should be investigated before consideration of the various filter techniques for the examination of water samples other than for experimental data or research investigations.

Tentative Acceptance

The tenth edition of "Standard Methods"[1] describes the test as a tentative procedure, but fails to recommend its use on official samples where equivalent results are demonstrated by filtration methods and multiple-tube methods. It also states:

> The study indicates that there is no readily apparent relationship between results secured by the membrane filter technique and the standard dilution tube procedure upon which the Most Probable Number index is computed.

This sentence, with the omission of approval with equivalent data and the absence of any values to be used as a guide in the interpretation of data by the filtration procedures would, under strict "Standard Methods" regulations, limit its use to research investigations and supplemental examinations.

Acceptance By Others

The "Interstate Quarantine Drinking Water Standards" recognize the membrane filter test as described in "Standard Methods" as an official procedure in the examination of potable waters for interstate carrier water points and other waters under the quality control regulations of the Public Health Service or other agencies of the U. S. Government. This authorization is found in the "Intention to Amend" published in the *Federal Register*, October 23, 1956, pages 8110-1, and amended in *Federal Register*, March 1, 1957, page 1271.

The standards of interpretation for the membrane filter test are defined with the permissible limits for the occasional occurrence of coliforms in a potable water sample. This authorization of the membrane filter procedure as an official alternate test does not apply to water under control of intrastate regulations, but it does signify acceptance of results wherever it may be used as an official test.

With the foregoing differences in the "Standard Methods" and the "Interstate Quarantine Drinking Water Standards," it would appear that the Board of Health having authority in any political subdivision could approve the membrane filter procedure for the bacterial examination of water where it considers it applicable, including interstate water points, without further approval, except in states where "Standard Methods" have been adopted by legislative action.

The "Interstate Quarantine Drinking Water Standards" provide for the interpretation of results of the test applied to potable waters. Briefly the provisions are as follows:

1. Arithmetic mean density of all standard samples examined per month by membrane filter procedure shall not exceed one coliform per one 100 milliliters.

Ed. Note: This article presented at 1957 Annual Meeting, Maryland-Delaware Water and Sewage Assn., has been released for publication in Water & Sewage Works.

2. An occasional sample may have:
(a) 3 coliforms on a 50-ml sample, or
(b) 4 coliforms on a 100-ml sample, or
(c) 7 coliforms on a 200-ml sample, or
(d) 13 coliforms on a 500-ml sample, or
(e) 22 coliforms on a 1,000-ml sample,

Providing it does not occur in
(1) Consecutive samples, or
(2) More than five (5) percent of samples when 20 or more samples per month are examined, or
(3) More than one sample when less than 20 samples are examined per month.

3. Provided further, that when one sample exceeds the above permissible limits, daily samples will be collected and examined until two consecutive satisfactory samples have been recorded.

The Technical Committee on Methods for the Bacteriological Examination of Boundary Waters (Jan. 20, 1957) believed that, after consideration of available information, the results of examination by membrane filter procedures and those obtained by the confirmed MPN test of "Standard Methods" were of equal sanitary significance in the interpretation of water quality. The membrane filter procedure was approved with the recognition that there would be occasional instances where an indeterminate MF result would occur due to algae, excessive turbidity, or colloidal precipitates, which would require a multiple-tube (MPN) test.

A few cities are now using the membrane filter test exclusively for potable water samples from both the plant and the distribution system. A larger group of cities are using both MF procedures and MPN tests while deciding which procedure to adopt.

Laboratory Errors

The technical procedures and equipment for the membrane filter test are fully described in "Standard Methods"[1] and in various publications in technical journals. Here are considered only certain parts of this procedure in which have been encountered the most frequent laboratory errors or mistakes in technical judgment.

Some laboratories have reported errors in technique as failures or as limitations of the membrane filter test. Common errors which may result in poor coliform determinations are:

1. Excessive number of colonies on membrane.
2. Errors in basic fuchsin-sodium sulfite ratio.
3. Elimination of enrichment period.
4. Low humidity during incubation.
5. Flooding membrane with medium.
6. Contamination of absorbent pads.
7. Air bubbles between membrane and absorbent pad.

Ideal membranes should have less than 60 coliform (sheen producing) colonies and not more than 250 or 300 total colony count. However, reasonably good estimated coliform counts can be made on membranes with 100 coliform colonies when the noncoliform colony density is low. Exceeding these limits results in missed coliform colonies due to suppression of sheen or a spreading growth over membrane with few distinct colonies. In estimating the size of the sample for filtration, the use of past coliform data is helpful. Such calculation should aim at a coliform colony density of 20 colonies on the membrane.

In the absence of any coliform data, three or four different quantities of water should be filtered the first time in order to establish an appropriate quantity for examination. In the examination of potable waters, 50- or 100-ml samples are most frequently used for untreated waters. For treated waters (including those treated by chlorination only) in the order of preference, best results are secured with 200-, 300-, or 100-ml samples. Samples of 100-ml size are generally used for examination of water from mains before resumption of service after repairs or installation of new lines.

Another source of poor results by the membrane filter procedure is an error in the ratio of basic fuchsin to sodium sulfite, used as an indicator system in the medium. An excess of basic fuchsin results in a toxic medium, with suppression of many coliform colonies. An excess of sodium sulfite inhibits the typical metallic sheen production by the bacteria of the coliform group.

Each lot of basic fuchsin must be biologically standardized for the fuchsin-sulfite ratio which will yield maximum coliform recovery with optimum coliform differentiation. If the biological standardization of the indicator system cannot be made in the plant laboratory, a few comparative tests should be made to show whether the fuchsin-sulfite ratio prepared locally gives results equivalent to those obtained with a sample of indicator which has been biologically tested. Samples of moderately polluted water should be used for comparative tests. Sewage or pure cultures should never be used in this standardization.

An enrichment period of approximately two hours on a nontoxic and nonselective medium is recommended. Some samples, such as fresh sewage with active coliform populations, show little decrease when the enrichment step is reduced or eliminated. It is essential, however, in waters where the coliforms have been exposed to any unfavorable environmental conditions. The enrichment period initiates growth of weakened or resting coliform cells. It may be considered comparable to the lactose-broth step in the confirmed test by the MPN procedure, in that it initiates growth in the absence of restrictive substances.

Reduced humidity frequently will permit the surface of the membrane to lose moisture more rapidly than it is replenished by the diffusion of medium from the absorbent pad. This may result in suppression or reduction of growth. A number of simple and inexpensive corrective procedures have been described in the literature to use in any type of incubator.

The next two sources of error can easily be eliminated by removing the excess medium from the absorbent pad before rolling the membrane on it, and by using sterile absorbent pads. Air bubbles between the membrane and absorbent pad can easily be recognized on SEC Endo-type medium by a colorless spot in the membrane. A membrane with no air bubbles on this medium is uniformly pink. The remedy for bubbles is to lift the membrane with sterile forceps and roll it again on the absorbent pad.

Observation of precautions to avoid the foregoing seven possible errors will eliminate the majority or disappointments and dissatisfaction with the membrane filter test. Excessive crowding of the membrane or poor media, with special emphasis on the fuchsin-sulfite ratio, are far the chief causes of poor results and unsatisfactory tests.

Other Limitations

There will be samples of water and sewage, with their great variety of pollutants found in some locations, for which the membrane filter procedure should not or cannot be used. These limitations can usually be recognized from the history or an inspection of the sample, during the filtration pro-

cedure, or an examination of the membrane after incubation. Most of these samples belong in one of the following groups:

1. Contain large quantities of colloidal precipitate or suspended solids in reference to quantity filtered.

2. Have an excessively high noncoliform bacterial population that can grow on an Endo-type broth with a negligible coliform density.

3. Contain at least 1 mg per liter of zinc or copper compounds, or both, as reported by Shipe and Fields (*Appl. Microbiol.* 2:382-384; 1954).

4. Contain (in a rare water sample) a bacterial strain fermenting lactose with rapid acid production on Endo-type broth but failing to produce gas in lactose broth fermentation tube.

The presence of suspended material in the sample may or may not be a limiting factor in the use of the membrane filter procedure. It will depend on the type of the suspended material and the thickness of the layer on the surface during incubation of the sample. Relatively thin layers of gelatinous or hydroscopic materials as suspended iron, manganese, or alum flocs, or algae, may clog the pores of the filter or they may, after incubation, result in a spreading film of growth.

On the other hand, much thicker surface layers of crystaline or silicious materials may cause little or no difficulty. The application or limitation of the procedure will not only depend on the thickness and nature of the suspended material on the surface of the membrane, but also on the density of coliforms. If the coliform pollution is sufficient to examine a sample not exceeding 2 or 3 ml in size, there is practically no danger of collecting sufficient suspended material, even algae, to cause any difficulty. However, if the quality of water is such that large quantities containing suspended material must be filtered, a multiple-tube method should be used. Pollution in streams like the Missouri, Mississippi or Ohio Rivers is sufficient to use the membrane filter procedure (over 500 coliforms per 100 ml).

An occasional water sample will contain 400 or more noncoliform bacteria capable of growing on Endo-type broth for each coliform organism present. This occurs infrequently because the Endo-type medium suppresses the growth of a large percentage of noncoliform bacteria normally present in water and sewage. This limitation has occurred twice in the experience of the authors, and both streams producing such samples were high in the western mountains. In such cases the membrane filter test cannot be used.

Some waters high in industrial wastes have been found to contain more than 1 ppm of zinc or copper compounds. Shipe and Fields have reported that the metallic ions are adsorbed on the membrane sufficiently to prevent bacterial growth. In such instances a multiple-tube test would be the procedure of choice.

Occasionally a water sample is encountered which contains a strain of bacteria able to grow on the Endo-type medium with a metallic sheen. These organisms produce large quantities of acid, but no gas in lactose broth. Because they are apparently confined to a very few locations and appear in these places only periodically, it has little effect on the application of filter techniques. They can be easily identified by transferring a number of sheen-producing colonies to lactose broth tubes with an indicator to show acid production. They are characterized by rapid acid in 24 hours at 35°C and failure to demonstrate gas production in 48 hours.

Advantages

From this discussion it appears that the membrane filter procedure is applicable in the majority of untreated waters. Certain limitations have been suggested in the application of the test, but from a practical consideration only those samples high in iron or algae and very low in coliform density will cause much difficulty. Such samples may be encountered in the examination of well waters or in some impounded waters or lakes.

Membrane filter application in the examination of filtered waters appears to have no exceptions from a technical viewpoint. Its major advantages are the examination of 200 to 400 ml of treated water, reproducibility of results, and completed examinations in less than 24 hours. In those plants where it is routine practice to examine further coliforms found in finished water, isolated coliform colonies can be picked directly from the membrane.

A delayed incubation membrane filter test has been developed to permit the filtration of a sample in a local water plant and completion of the test in a central laboratory. The procedure consists of filtering the sample, placing the membrane on benzoated Endo-type (preservative) medium in a sterile 1-ounce ointment tin, and sending it to the central laboratory. In the central laboratory the membrane is transferred to SEC Endo-type medium and incubated at 35°C for approximately 18 hours; then coliform colonies are counted as they are for the immediate membrane filter test.

Membranes reaching the central laboratory within 72 hours give coliform data equivalent in sanitary significance to data obtained from liquid samples stored at 5°C for 24 hours. Practical advantages are:

1. Membranes after filtration on preservative medium are stored or transported at ambient temperature without refrigeration.

2. Transportation cost is approximately 3 cents per sample plus 6 cents for the mailing carton which will accomodate up to seven samples.

3. Changes in coliform densities on the preservative medium are generally negligible between collection and analysis.

4. A single central laboratory can supply bacteriological services to numerous small water supplies or examine samples in collaboration with other laboratories.

The same precautions and limitations apply to the use of the delayed incubation test as for the direct membrane filter procedures. The delayed test has been extensively investigated during the past year by parallel examinations of raw and treated water by the delayed incubation procedure, immediate MF procedure, and "Standard Methods" MPN test on about 5,000 samples from 14 locations in the continential United States.

Preliminary analysis of the results indicates that the delayed incubation MF technique yields results comparable to the immediate MF test and similar in sanitary significance to the results by the MPN procedure. The delayed test is useful especially for testing waters that cannot be examined soon after collection and must be sent by public transportation to a laboratory for analysis.

References

1. "Standard Methods for the Examination of Water, Sewage, and Industrial Wastes." 10th Edition, pp. 395-401. Amer. Pub. Health Assn., New York, N.Y. (1956).

2. Geldreich, E. E., Kabler, P. W., Jeter, H. L., and Clark, H. F., "....." *Amer. Jour. Pub. Health*, 45: 1462-74 (1955).

Ed. Note: Although "Standard Methods" is published by the Am. Pub. Health Assn. it is now produced, and sold jointly by the Am. Water Works Assn., the Federation of Sewage & Ind. Wastes Assns. and the Am. Public Health Assn.

DRAMATIC underside view of the reservoir roof. Note interesting pattern of connected triangles.

Timber Reservoir Cover

Town of Beavertown, Oregon protects its water supply with low-rise dome of treated timber

by **HOMER HATHAWAY**
Technical Writer
Everett, Wash.

WHAT can a small town, with a limited budget do to protect its water supply from being used as a private swimming pool by rodents and animals, as well as a catch-all for an odd assortment of human cast-offs?

The town of Beaverton, Oregon was faced with just that problem. Twenty-five years after construction of the reservoir, it was decided that a roof would be the logical answer. Unfortunately, that decision presented other problems.

The reservoir was located right in the center of a choice residential district, making it imperative that any roof structure be completely unobtrusive. That meant it had to be low, attractive, durable, and, since the budget would not stand too much stretching, inexpensive.

Beaverton water board engineers William Hege and D. A. Huston described their problem to the engineers of Timber Structures, Inc., who designed a novel timber dome, rising thirteen feet above the reservoir walls. The design was accepted, and Timber Structures set about prefabricating and erecting the dome.

Because the reservoir is circular, the 75-foot wide dome was designed in that shape. The roof section was divided into six pie-shaped segments, each of which was divided circumferentially by members of equal length. Diagonal members intersect to form a series of triangles which are joined together by pipe universal joints into which members may come from any angle.

Sections of the dome were cut from 2x6's of structural grade Douglas Fir. They received a preservative treatment of 5% pentachloro-phenol-petroleum with a minimum net retention of six pounds per cubic foot. Dividing each triangle is a 6x4 header of Douglas fir which runs circumferentially around the dome at intervals of 2½ feet to the crown.

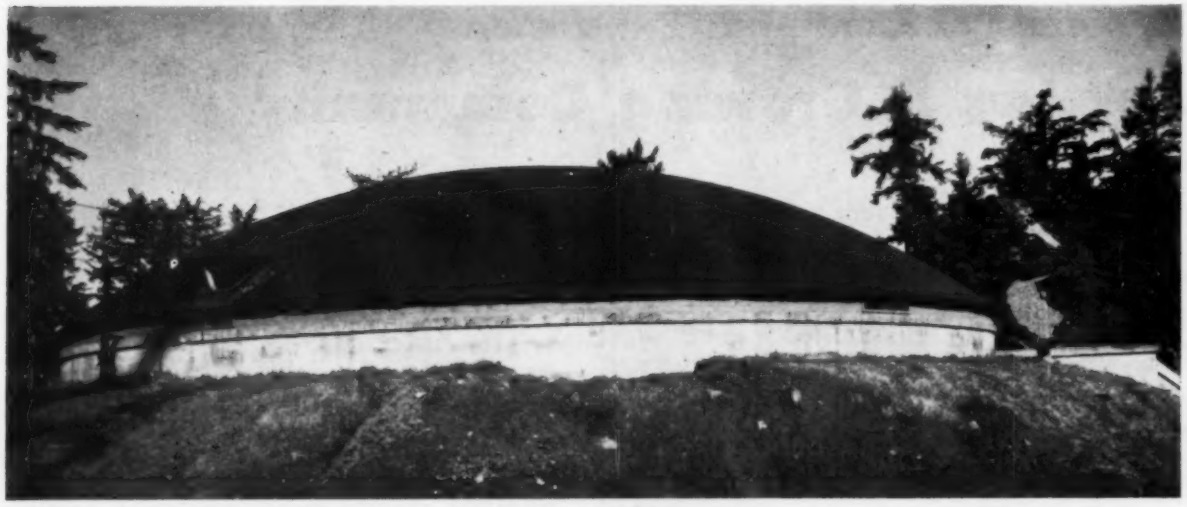
In assembling the timber roof framework, the builders started at the center and worked toward the outside edge; as the structure grew in size, it was raised on three gin poles and hoisted into position on top of the reservoir wall. Then it was joined to the reservoir by sturdy pipe columns spaced equally around the wall perimeter, and connected together by a steel tension ring which resists the horizontal thrust of the structure. The dome was then covered with one-inch tongue-and-groove cedar sheathing, noted for its long wear under exposure conditions. A built-up roof surface was applied.

The entire dome is light in weight, but is solid and has unusual stiffness and rigidity. The design has proven especially practical for existing reservoirs, since reactions are distributed evenly over the periphery, thus eliminating concentrated loads which would require special footings or reinforcing of the existing structure.

Timber Structure's engineers say there is practically no limit to the size of similar roof structures built along the same design. Features which appealed to Beaverton authorities were the speed of fabrication and design of the roof, and the over-all cost, which was $2.04 a square foot.

DETAIL of pipe columns welded to universal joints at the outer edge of the dome structure

Note steel strap between columns which acts as tension ring.



COMPLETED low rise dome (13 ft) covered with cedar sheathing and built-up roof surfacing.

General Waterworks Going After Rate Increases

General Waterworks Corp., which operates 85 water companies in the U. S., expects to earn $2.00 per share on its stock during 1957 and continues buying new properties all the time. This year the company has already acquired additional water supply properties in R.I.; Pa.; Ill.; N.C.

Howard Butcher III, president of General Waterworks, is making no secret of the feeling that the Corporation has "fallen way behind" in applying for rate increases when compared with other utilities such as telephone, electricity and gas. Applications for more than a dozen rate increases will be made in the immediate future. If obtained the anticipated $2.00 per share earnings for 1957 should be exceeded. Mr. Butcher stated that the Corporation plans continuance of its policy of rewarding common stockholders with a 6% bonus in the form of a stock dividend.

CHOUTEAU raw water plant, located on the Mississippi River, was built in 1927. Grit tanks at right.

72 Years of Continual Expansion

Serving A Growing Community

by STEPHEN C. CASTEEL

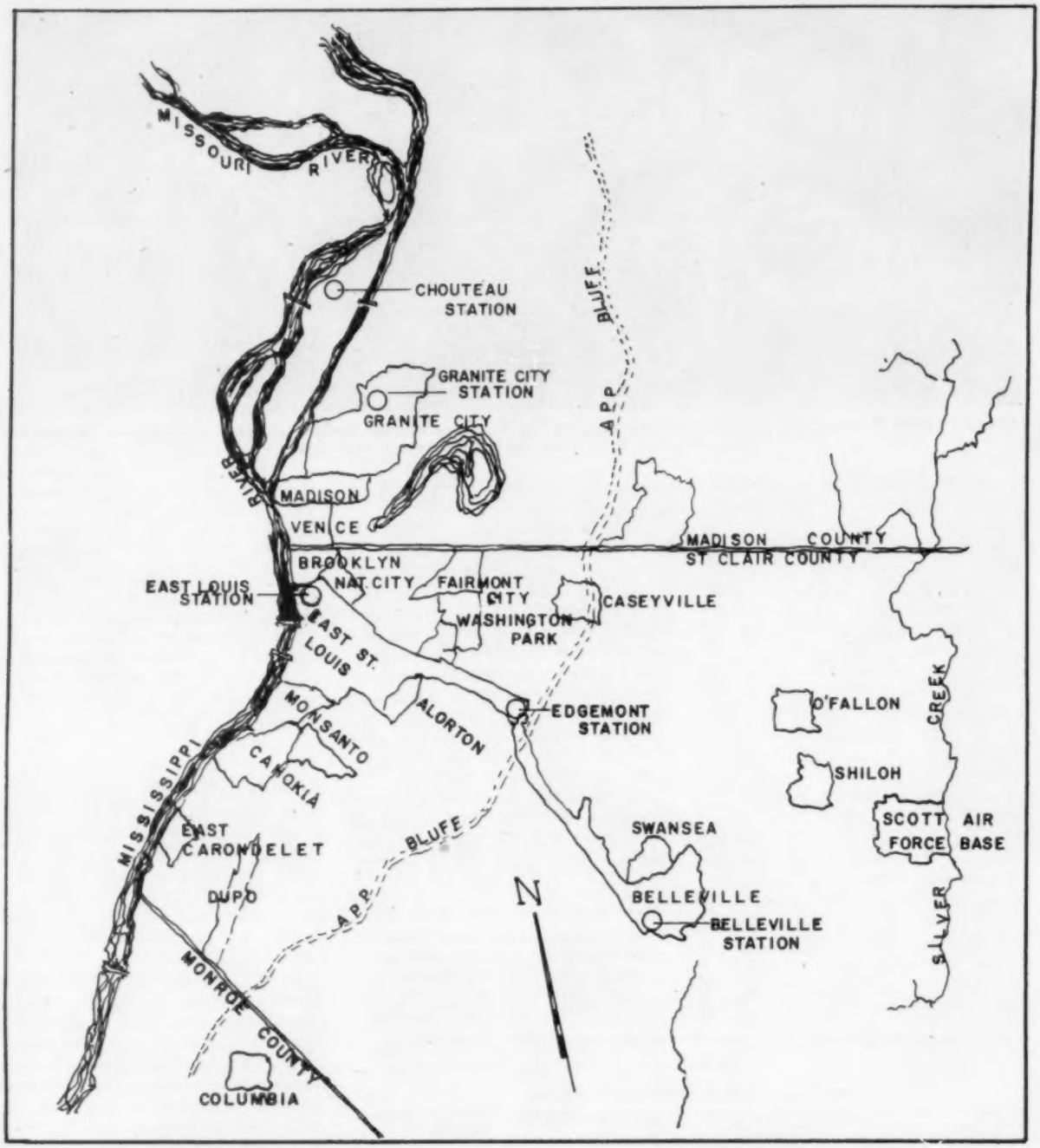
Mr. Casteel retired as Manager of the East St. Louis and Interurban Water Co., East St. Louis, Ill., on April 1, 1957. In this article he reviews the steady growth of the second largest water utility in the State of Illinois. He has established an office for consulting services in the Goldman Bldg., E. St. Louis, Ill.

DURING the past 72 years. the East St. Louis and Interurban Water Company has developed from a single pump taking water from the Mississippi River and delivering it to a small distribution system, to the second largest water utility system in the State of Illinois.

This integrated operation supplies water to 19 cities, towns, and villages, 2 water districts and 1 large military establishment, situated in St. Clair, Madison and Monroe Counties. Water is delivered through 60,000 service taps connected to 670 miles of distribution mains. The two water districts and five towns purchase water for resale to some 11,000 consumers attached to their own distribution systems. The total consumer taps served are, therefore, about 71,000 to an estimated population of 280,000.

The system is built around three population centers; namely, East St. Louis, population 83,000; Belleville, population 33,000; Granite City, population 30,000. The present company resulted from consolidation on August 15, 1916, of the City Water Company of East S. Louis, the Granite City Water Company, and the Belleville Water Supply Company.

East St. Louis Illinois, the metropolis of the system, is located directly opposite St. Louis Missouri, on the east side of the Mississippi River, which separates the two cities. It was here in 1885 the water system was started, to supply the community



SERVICE AREA and location of stations of the East St. Louis and Interurban Water Co.

which had grown from a population of 5,644 in 1870 to a population of about 12,000 in 1885. This rapid early growth can be attributed to the construction of the historically famous Eads Bridge, which was opened July 4, 1874. This transportation facility, linking the eastern states with the New West, provided the impetus for rapid growth in the immediate areas adjacent to the bridge. East St. Louis, Illinois, being ideally situated was at this early date obviously destined to become one of the larger industrial areas of a growing country. The first requisite was, of course, a suitable and adequate water supply.

Early History

In 1885 Frank M. Horner,* a hydraulic engineer, was sent to East St. Louis by the American Water Works and Guarantee Company to develop the supply. A site was selected one mile upstream from Eads Bridge, where a pumping plant was constructed which included five 80-hp steam boilers and a Worthington duplex reciprocating pump of 3-mgd capacity, with an 18-inch cast-iron suction line about 300 feet in length to the Mississippi river. The pump discharged to a distribution system of about 5 miles of pipelines ranging

*Frank M. Horner built the system and managed the operation until 1914, when he was succeeded by his son Charles M. Horner, who was Manager until his retirement in 1940.

EAST ST. LOUIS pumping and purification plant showing four Dorrco-Aldrich Peritilters under construction. Rectangular basin in center background has been in service since 1887.

in size from 20 inches to 6 inches, some of which are still in service 72 years later.

In 1886 the City Water Company was in business serving 156 consumers. Typical of the practice in water supply development of the period, the initial installation delivered untreated river water under pressure into the distributing system. The immediate need for expansion to provide an improved quantity and quality of water was apparent, and work to accomplish this was started in 1887 when, by April 1, the consumers connected to the system had increased to 407.

A masonry 430 feet long, 160 feet wide, and 15 feet deep, was provided to hold 8 mg. The basin was divided with a wall through the center. A 16-inch cast-iron pipe to and an 18-inch cast-iron pipe from the basin, each 1,500 feet long, were provided. A standpipe, 15 feet diameter and 100 feet high, was erected and a Dean Compound duplex pumping unit of 3-mgd capacity was installed.

These added facilities, completed about two years after the system was started, provided partial clarification, which functioned as follows: The first pump delivered water to the basin, where a liberal retention period was provided. The second pump received settled water from the basin and delivered it to the standpipe, which was connected to the distribution system.

One of the early consumers was the National Stock Yards, the largest industry in the area at the time. The stock yards had developed its water supply in 1873. The following, from "History of East St. Louis," by Robert A. Tyson (1875), is of interest:

Water Works of the National Stock Yards

They were built in 1873, by William Bement, engineer, who has had them since in charge. The building is seventy feet high. Supported at the top by immense timbers, crossed and braced in all directions in the main part of the building, from the ground up, are three great wooden tanks, holding 600,000 gallons of Cahokia Creek water. It is conveyed by main pipes, 8 inches in diameter, to the vast yards, and through its avenue and streets by mains 3 inches in diameter. In the yards are 27 fire hydrants connecting with the mains. To these rubber and linen hose are connected in case of fires. Several more manufactories in the vicinity could be supplied by these works in the same way.

By 1890 East St. Louis had enjoyed a substantial increase in population—from 5,644 in 1870 to 15,169 in 1890—and was firmly rooted as a thriving center of industry and commerce. The water requirements were being provided by the continual addition of plant and equipment. The consumers in 1890 had advanced to 847, or 1 tap per 18 population.

In 1890-1 a circular pit 50 feet in diameter was added to the original structure to house two Holly-Gaskill crank-and-flywheel pumping units, one of 8-mgd and one of 6-mgd capacity. These two pumping engines were to perform a remarkable service record. They served at the initial location until 1904, then were moved and re-erected at the new station being built. The 8-mgd engine remained in service until 1938, or a period of 48 years. The 6-mgd unit was dismantled for salvage in 1953 after a service of 63 years. Both engines were in operating condition when removed, and had served as standby equipment for several years preceding removal.

The pumping facilities in 1891 consisted of 14-mgd installed capacity to handle clarified water and 6-mgd installed capacity for pumping raw water from the river to the basins. Additions to the distribution system,

TABLE I

Towns and Districts Included in System

East St. Louis Division	Granite City Division	Belleville Division
East St. Louis	Granite City	Belleville
Brooklyn	Madison	Caseyville[1]
National City	Venice	O'Fallon[1]
Fairmount City		Shiloh[1]
Washington Park		Swansea
Alorton		Scott AFB
Monsanto		Stookey[1,3]
Cahokia		
Dupo[1]		
East Carondelet[2]		
Columbia[1]		
Commonfields[1,3]		

[1]Purchases for resale. [2]Purchases from Dupo. [3]Water district.

which had reached 53 miles by 1900, continued to serve the increased demand for service. In 1900, 3,763 services were attached to the system, serving a population of 29,655, or 1 tap per 7.9 population.

Rapid Sand Filtration Introduced in 1900

A major addition was made to the plant in 1900 to meet the increasing demands for service. Eighteen New York filter tanks, 8 feet in diameter by 30 feet long, with a sand surface area of 207.7 square feet and a capacity 0.61 mgd each, were installed in a newly constructed building to function as gravity rapid sand filters, receiving settled water from the basins built in 1887. From the filters the water flowed to a clear water basin of 1.6-mg capacity, then to the suctions of pumps for delivery to the distribution system. A 10-inch wash water pipe was constructed from the standpipe.

It is significant to observe that the year 1900 did not see many complete water treating plants, whereas East St. Louis had completed a system making use of sedimentation and rapid sand filtration. Available records do not indicate the use of coagulants, but it is believed that some use of coagulant was made as early as 1900.

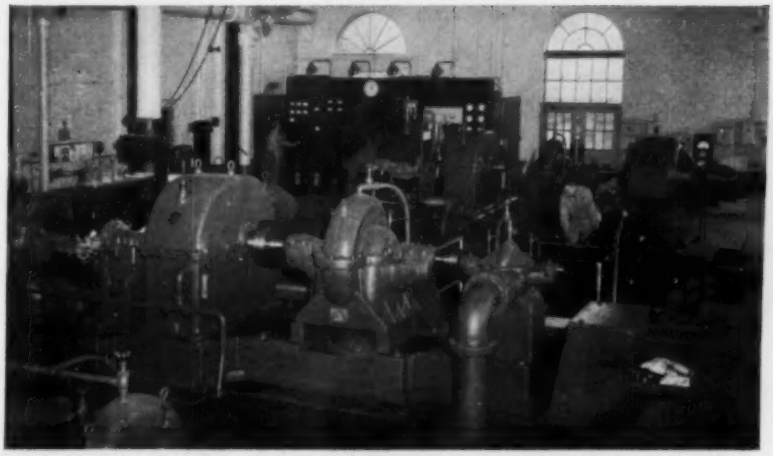
Upon completion of the 1900 additions, the plant was capable of filtering at an 11-mgd rate. The supply works seemed adequate, but not for long. In 1903 four American filter units, 15 feet in diameter by 10 feet high, were installed in an 89-foot extension to the filter building.

New Pumping Plant Built

In 1904 a complete new pumping plant, to be designated as the High Service Station, was built. This converted the existing pumping station to exclusive low-service duty. Equipment installed in the new plant included three Heine water-tube boilers, the two crank-and-flywheel pumping units originally installed at the first station, also one Worthington reciprocating pump of 5.0-mgd capacity, and a Prescott reciprocating pump of 5.6-mgd capacity.

Raw Water Plant

The original plant was converted to exclusive raw water pumping. The installed equipment included 1 Worthington 10-mgd (1900), 1 Worthington 5-mgd (1901), and 1 Wood 10-mgd (1902) pump. A substantial addition was made to the treatment facilities in 1906, when two sedimentation basins were built, each 100 feet by 220 feet by 14 feet deep, or 2.3-mg capacity. As the decade 1900-1910 came to a close, East St. Louis had reached a population of 58,547, having almost doubled during the 10-year period. The consumer taps on the system had more than doubled, reaching 9,637, or 1 tap per 6+ population.



PUMP ROOM of East St. Louis plant, showning three of the four centrifugal pumps driven by steam turbines.

Acquisition of Granite City and Belleville Supplies

During this decade the acquisition of other supplies in neighboring towns was accomplished; namely, the Granite City Water Company of Granite City, Illinois, in 1900, and the Belleville Water Supply Company of Belleville, Illinois, in 1908. Although East St. Louis and Belleville were established communities in 1890, Granite City was just being born, so to speak. It was invisioned by the pioneers that here in this bottom land, adjacent to the mighty Mississippi River, a center of industry could be built. They built well, for today the city of 30,000 population is an industrial center, the largest industry being the Granite City Steel Company.

The water supply works was constructed in 1893 at Gabaret Island, taking its supply from the Mississippi River. Two basins were constructed, 86 feet wide by 387 feet long, of 4-mg capacity each. Boilers and pumps were provided, and 17,000 feet of 18-inch cast-iron pipe to convey the water to a point that would ultimately become the center of the town. The population was under 1,000 at the time. The town site was platted and the town organized in 1897.

The water supply works was acquired by the American Water Works and Guarantee Company in 1900. In 1905 facilities were provided for applying a coagulant to the water in the basins. At the time of acquisition, the distribution system contained 58,000 feet of cast-iron pipe ranging in size from 12 inches to 4 inches in diameter and 10,000 feet of 2-inch wrought iron pipe, in addition to 17,000 feet of 18-inch transmission

TABLE 2

Additions to East St. Louis and Interurban Water Company System[1]

Year	Distr. Gains, Miles	Services	
		Number	Gain During Period
1886	5	156	
1890	22	847	691
1900	53	3,763	2,916
1910	204	14,344	10,581
1920	280	20,550	6,206
1930	444	36,700	16,150
1940	465	40,578	3,878
1950	565	50,374	9,796
1956	668	60,348	9,974

[1]Starting with 1910, the East St. Louis, Granite City, and Belleville Divisions are included.

GRANITE CITY pumping and purification plant. This 12-mgd station was placed in service in August 1950.

main. No record of consumer taps prior to 1903 are available. At this time 1,405 were recorded. The population in 1900 was 3,122, which was tripled by 1910, reaching 9,903. At 1910 the consumer taps were 2,390, or 4+ population per tap.

The Granite City system was a self-contained operation until 1918, when a connection was made to the East St. Louis system. This connection provided filtered water to Granite City. The station at Gabaret Island was held as a reserve. The basins were used as clear water reservoirs and, when necessary, water from these reservoirs was pumped to the Granite City system and the amount so withdrawn was replaced during periods of low demand.

Belleville, Illinois

Belleville, county seat of St. Clair County, was in existence four years before the State of Illinois was admitted to the Union, which occurred December 3, 1818. The people who had settled in the bottom lands adjacent to the river concluded the seat of county government should be established on higher ground. The spot selected, known at the time as Compton Hill, has in 143 years of steady progress risen to the present city, a center of industry, mining and farming.

The Belleville Daily Advocate in its centennial issue, published October 25, 1939, contained an informative and interesting historical description of each segment of community resources, which of course included the water supply. The following are excerpts taken from that issue:

No citizen of Belleville ever died of thirst, but at times the town nearly did. For nearly a century of stormy progress elapsed before the unlimited supply of water was secured. From the town pump to the Mississippi river was a long battle.

Like all other pioneer cities, Belleville had no regular water system, depending on small private wells and the town pump. But shallow wells can go dry overnight as occurred in 1854.

The Belleville fire department began in 1841. As an incentive to speed the volunteers, a reward was offered by the town board in 1848 of $2 for the first water cart to arrive at the scene of a fire and $1 for the second cart.

About 1863 the city engineer, at the request of the town board, made plans whereby 24 cisterns were dug in Belleville of 1,000-barrel capacity to cost approximately $52 each. 300 feet of hose attached to each pump would reach any fire in any part of the city and the closest cistern.

A new steam fire engine was purchased December 14, 1876, which was the first engine of its kind in the middle west.

Many false starts towards a water works were made, companies incorporated, but all in vain until 1885 when a city-wide system of mains fed by lake reservoirs was constructed by the Belleville City Water Works Company.

Impressive as these figures may seem, the lakes couldn't cope with the growing demands. Each summer the supply was threatened.

New Development for Belleville

In 1907 a well supply was developed in the American Bottoms at the foot of the Edgemont hill and a pumping station was constructed. The well supply proved unsatisfactory and finally a connection was made with the East St. Louis system when a 16-in. pipeline was laid to the Edgemont station. On September 12, 1912, Belleville, Ill. started receiving its water supply from the Mississippi River. At this time there were 2,462 consumer taps in the Belleville system, which was about 1 per 9 population. It is obvious that many people in Belleville used individual wells or cisterns rather than the public supply prior to the time the city was provided with a dependable and safe supply.

Three Systems Consolidated

The East St. Louis, Granite City, and Belleville systems were consolidated in 1916, thus forming an integrated operation to be known as the East St. Louis and Interurban Water Company. Additions were continued; six American filters were added. In 1917-18, 12 rapid sand concrete filters and a modern coagulant building and equipment were constructed. An additional settling basin of 4.5--mg capacity was built in 1917; followed by No. 2 clear well, of 3.0-mg capacity, in 1918. By 1920 a total filtering capacity of 28 mgd in 40 units was available.

Other treatment facilities included five settling basins with total capacity of 17 mg, and two clear water storages of 4.6 mg capacity. At the close of 1920, 20,550 consumers were being served and during the year an average of 21 mgd was delivered to the combined system, including a relatively large industrial load, which accounts for the high consumption per consumer.

Introduction of Centrifugal Pumps

During the next ten years, 1920-30, centrifugal pumps, with prime movers consisting of motors and steam turbines were introduced to the pumping plants. During 1928 a 16-mgd steam turbine-driven centrifugal pumping unit was installed at the East St. Louis plant. A new water-tube boiler with superheater was provided to furnish steam of a suitable quality to the turbine.

New Raw Water Supply

In 1927 a new source of raw water supply was provided. This facility is located north of Granite City on the Mississippi River, 11 pipeline miles from the East St. Louis treatment plant and about 3 miles downstream from the mouth of the Missouri River. The installed equipment included revolving screens and 75-mgd motor-driven centrifugal pumping equipment in three units.

The pump delivers water from the

river through two grit tanks and 23,902 feet of 54-inch Lock Joint concrete pipeline to Granite City, then 35,019 feet of 48-inch Lock Joint pipe to the treatment plant in East St. Louis. The pump building is located directly on the bank of the Mississippi River.

By 1930, 36,700 consumers were being served by the system. The average daily delivery of 19.8 mgd during 1930 was a little under the average for 1920, due to the depressed economic conditions of the period, which caused a curtailment of industrial load. It is interesting to note that the yearly pumpage of 7,770 mg attained in 1920 did not recur until 1941, when the increased industrial activity created a new peak for one year of 7,813 mg. During the period 1920-41 additional consumers were added each year except 1939.

Improved Efficiency

During the decade 1930-40 substantial improvements directed to an improved efficiency were made. The high service station, which had been built and equipped in 1904, was provided with modern boiler equipment by the installation of three units of 300-psi pressure, equipped with superheaters and spreader-type stokers. The second steam turbine-driven centrifugal pumping unit of 16 mgd was installed with an electrical alternating current generator on the same shaft, which provided the electrical energy for auxiliaries in the plant. During 1940 an average of 20 mgd was delivered to the system, to which 40,578 consumers were connected.

Starting with 1940, by reason of the necessity for providing defense materials from this highly industrialized area, the demands on the water supply were at an all time high and, because of the scarcity of materials, it became necessary to improvise with temporary installation of booster pumps to serve until pipe for main extensions became available. Five such booster pumps were installed at strategic locations in the distribution system. With the war ending in 1945, the last half of the decade was one of resumed construction, and during 1947-48 an all-time record was established for pipeline installation, with 125,000 feet having been installed during each of the two years. Although the delivery to the system dropped about 8 percent in 1946 due to cutbacks in defense materials, it was obviously a temporary situation and the trend pointed upward. The construction schedule was planned to meet an anticipated long-term growth, which has since proved to be proper. Pumpage to the system quickly recovered as industry adjusted from war to peacetime requirements and 1947 showed on increased pumpage of 16 percent over 1946. As the decade 1940-50 came to a close, although the history of the system had been one of constant growth, it was still apparent that major additions would be required in the immediate future.

New Granite City Plant

Construction of a complete new plant to serve the Granite City area was started in 1949. It had been previously decided to abandon the Gabaret Island station. In this connection 8,700 feet of 18-inch and 8,400 feet of 20-inch cast-iron pipe, which had been transmission mains from the Gabaret Island station to Granite City, were removed, reconditioned by cement lining, and re-installed at other locations. The new 6-mgd pumping and purification plant was placed in operation in August 1950. It pumped to an elevated storage tank of 0.5-mg capacity that had been constructed.

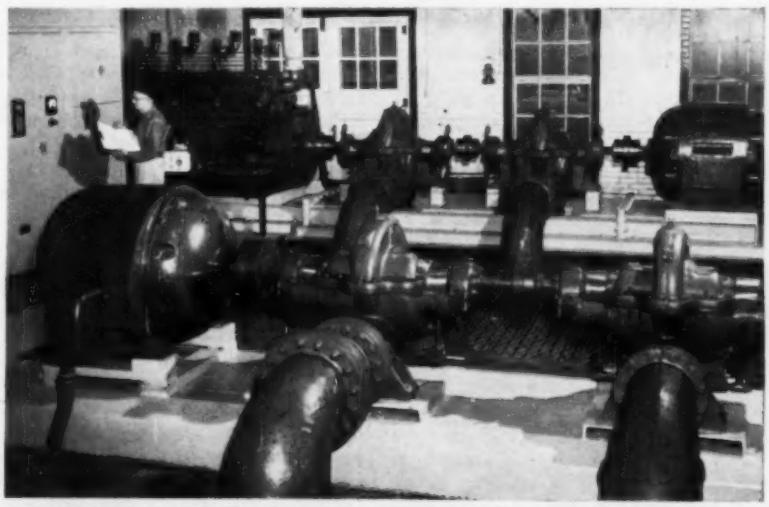
These new facilities assured Granite City of stabilized pressures and sufficient quantities to meet the growing demand on the northern portion of the system and further relieved the load which had imposed a strain on the main plant in East St. Louis. At the end of 1950 more than 50,000 consumers had used an average of 20 mgd over the year. Additional filter capacity of 4 mgd was provided at East St. Louis in 1949.

Over the entire service area the growth was pronounced. To provide for the increasing needs in the Belleville area, located in the upland approximately 200 feet higher than East St. Louis, expansion and modernization of the booster plant were completed during the late 1940's. This plant, known as the Edgemont station, is located at the foot of the bluff 8 miles southeast of the main station in East St. Louis. Water flows into storage tanks, of 5-mg capacity in two units, from the main system. The pumps take suction from the tanks and deliver to the Belleville system, which includes storage facilities, a standpipe, and pumps located 9 miles southeast of the Edgemont station. These facilities, which had been steam operated for many years, were completely electrified and more adequate storage was provided. Delivery to Belleville averaged 4.5 mgd during 1950.

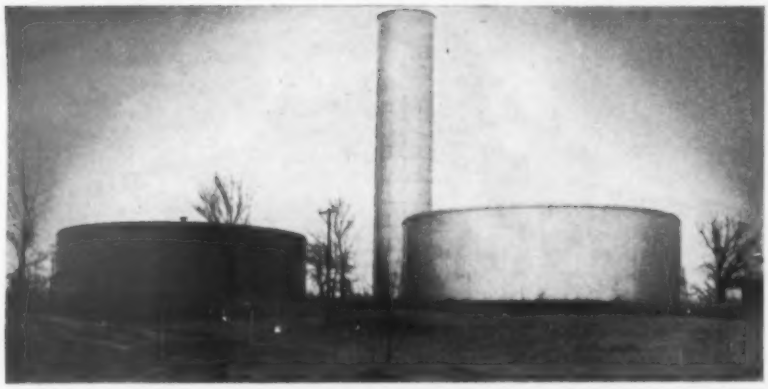
Since 1950

The boom in home construction so prevalent in many sections of the country after World War II was experienced in this area in astounding proportions. Ideally located within easy distance of places of employment, scores of subdivisions rose to supply the demand for houses. This situation prevailed over the entire service area, which of course denoted the requirement of additions to both plant and system.

The capacity of the Granite City plant was increased from 6 mgd to 12 mgd; 10-mgd filter capacity, consisting of four Dorrco Aldrich units, was added to the East St. Louis plant. Additional storage and pipelines were added to the system to meet the re-



EDGEMONT pumping station serves Belleville Division, some 200 feet higher than the East St. Louis and Granite City areas. Two of the three installed pumps are shown.



BELLEVILLE station has two 2-mil gal storage tanks and standpipes. The Edgemont station pumps to this standpipe and storage.

quirements for service. The residential consumption had increased from 88 gallons per consumer tap per day in 1940 to 117 gallons in 1956. During the same period the industrial consumption per unit per day had more than doubled, from 22,312 gallons to 55,739 gallons. Water delivered to the system exceeded 37 mgd average for 1956, with a maximum day of 46 mgd. In 1940 the average was 20 mgd, with maximum of 26 mgd.

The growth was anticipated and additions were consistently made to meet the requirements, which of course involved large capital expenditures. It became increasingly apparent that higher efficiency was essential to meet the increasing cost of operation. The East St. Louis plant, where 85 percent of the water is treated and pumped, had always been steam operated, with coal as fuel.

Studies indicated that introduction of natural gas as a base fuel, with oil as standby, would produce substantial savings in steam generation costs. This was accomplished in 1951-2. Installation of two additional steam turbine-driven centrifugal pumps provided a total installed capacity of steam turbine-driven centrifugal equipment of 62 mgd. Two of the steam turbine units have electrical generators on a common shaft with the pump, of sufficient capacity to provide energy for the raw water auxiliary plant that had been converted to a motor-driven operation by the installation of three 12-mgd units.

At the close of 1956 the facilities of this integrated system were at the peak of efficiency and reliability. The system serves an area widely known as an industrial center. Located on the east side of the Mississippi River and being one of the great railroad centers of the world, East St. Louis is ideally situated for the movement of raw and finished materials. Granite City also is an industrial center and has the added advantages of a port city, being located on the Chain of Rocks Canal. Its largest industry, the Granite City Steel Company, utilizes the port facilities in shipping its products via the Canal and Mississippi River. Belleville, located inland, is a city of industry, an agriculture center, and is exceptionally well located for ideal living conditions.

By reason of its geographical location, its variety of industry and its natural appeal to the homeseeker, the area provides the water utility the advantages that come with diversification of service. During 1956, 50 percent of the delivery was to industry, 16 percent to residential, 9 percent to commercial and 11 percent to municipal and other water utilities. The balance of 14 percent was for miscellaneous, plant uses, and unaccounted.

Present Production Facilities

The production facilities have the advantage of being, to a considerable extent, self-contained. The largest base-load plant is steam-operated, with the choice of gas or oil for fuel. This plant also generates power to supply one of the raw water plants located 1,500 feet from the main station and controlled from the main station. The stations utilizing purchased power have at two sources of electrical energy.

The production facilities at present consist of two water pumping plants, Chouteau Island and East St. Louis, with a total installed capacity of 126 mgd in six pumps; and two complete treatment and pumping plants, East St. Louis and Granite City, with a total combined capacity of 54-mgd filtration in 54 units, and 90-mgd pump capacity in nine units. The Belleville system is supplied from the Edgemont station, which contains an installed pump capacity of 14 mgd in three units. This station, in 1956, delivered an average of 6.3 mgd to the Belleville area. The Belleville station receives its supply from Edgemont and is used during periods of heavy consumption, drawing water from both storage and delivery to the systems.

Summary

The beginning of this 72-year old operation was antedated by only ten supply plants in the State of Illinois including, of course, Chicago, which was established in 1840. After starting, it moved rapidly to provide facilities to improve the quality, as is attested by the construction of the settling basins in 1887 and the installation of gravity sand filters in 1900. Many much larger cities in this country did not provide filtration equipment until many years after the turn of the century.

As the service area expanded, additions were consistently made to keep pace with a growing community. By reference to the map and list of towns, the extent of the area served can be visualized. From north to south the distance is 25 miles. From the river to the most easterly consumer, Scott Air Force Base, is 20 miles.

Although the system is interconnected, the operation is controlled by divisions. The area served is one of the fastest growing in the country in both industrial and residential building, and future growth may outdistance the past for a given period. No difficulty is anticipated with the water supply, however, as it is geared to handle the anticipated growth in the same efficient manner it has throughout its long history.

WATER WORKS PRACTICES

Water Softening

Part 1—Causes of Hardness and Reasons for Reduction

The forty-second of a series

by GEORGE E. SYMONS, Ph D.

In this series, Dr. Symons discusses water works practices in the form of short school lectures, designed to assist operators, students, and others who wish to review fundamentals in this field.

A . . . Hardness

1 . . Definitions

a. It has been said that the term "hard water" was originally used before the advent of water chemistry to describe water which caused vegetables such as beans and peas to become tough or "hard" when boiled.

b. The modern definition of hardness is " a characteristic of water . . . which causes curdling of the water when soap is used, an increased consumption of soap, the deposition of scale in boilers, injurious effects in some industrial processes, and sometimes objectionable tastes in water."

2 . . Causes of Hardness

a. In most cases, hardness is due to the existence in water of dissolved carbonates, bicarbonates, sulfates and occasionally the nitrates of calcium, magnesium, and iron, but aluminum, manganese, strontium and zinc may also be included.

b. "The theoretical hardness of a water is the sum of the concentrations of all the metallic cations, other than the cations of the alkali metals, expressed as equivalent calcium carbonate concentration." This value is termed total hardness.

c. The psuedohardness of brines is due to the high sodium content which prevents sodium soaps from going into solution.

3 . . Types of Hardness

a. When the total hardness value is numerically equal or less than the sum of the carbonate and bicarbonate alkalinity, then all of the hardness is carbonate hardness.

b. When the total hardness value is numerically greater than the sum of the carbonate and bicarbonate alkalinity, then the difference between the two is termed "non-carbonate hardness" and the alkalinity value is termed "carbonate hardness."

c. Before modern sanitary engineering chemistry, the terms, "temporary hardness' and 'permanent hardness' were in use. Temporary hardness was that hardness which could be removed by boiling the water; permanent hardness could not be removed by boiling.

(1) It was thought that temporary hardness was due to carbonates, and that permanent hardness was that due to sulfates and chlorides.

(2) Actually, temporary hardness was only that which could be removed by boiling the water and did not include all of the carbonate hardness, particularly when magnesium was present, since calcium carbonate is soluble to the extent of approximately 20 mg/L and magnesium carbonate is soluble to the extent of approximately 100 mg/L.

(3) These older terms should not be used since they are only approximate and may be quite misleading.

4 . . Amounts of Hardness

a. Waters are considered soft or hard, according to the amount of theoretical total hardness therein.

b. According to Fair and Geyer, "Waters containing less than 50 mg/L of hardness are considered soft; those containing more than 100 to 150 mg/L, the magnitude depending upon the regional composition of available water supplies, are considered hard."

c. Since hardness of water is caused by the solution of chemical salts, it is to be expected that the natural hardness of water supplies will vary according to the source of water.

(1) Ground waters generally have a greater hardness than surface supplies.

(2) Water supplies in the Mississippi River basin are generally harder than those in the eastern and western states.

(3) In 1934, the National Resources Board issued a "Report of the Water Planning Committee", in which two maps were published to show the hardness of both surface and ground water supplies in the United States. (See Fig. 1.)

5 . . Determination of Hardness

a. There are three fundamentally different methods of determining the hardness of water.

b. *Calculation* is the most accurate method and requires a complete a-

Ed. Note—Dr. Symons is Executive Vice President and Editorial Director of the Scranton Publishing Co., Inc.

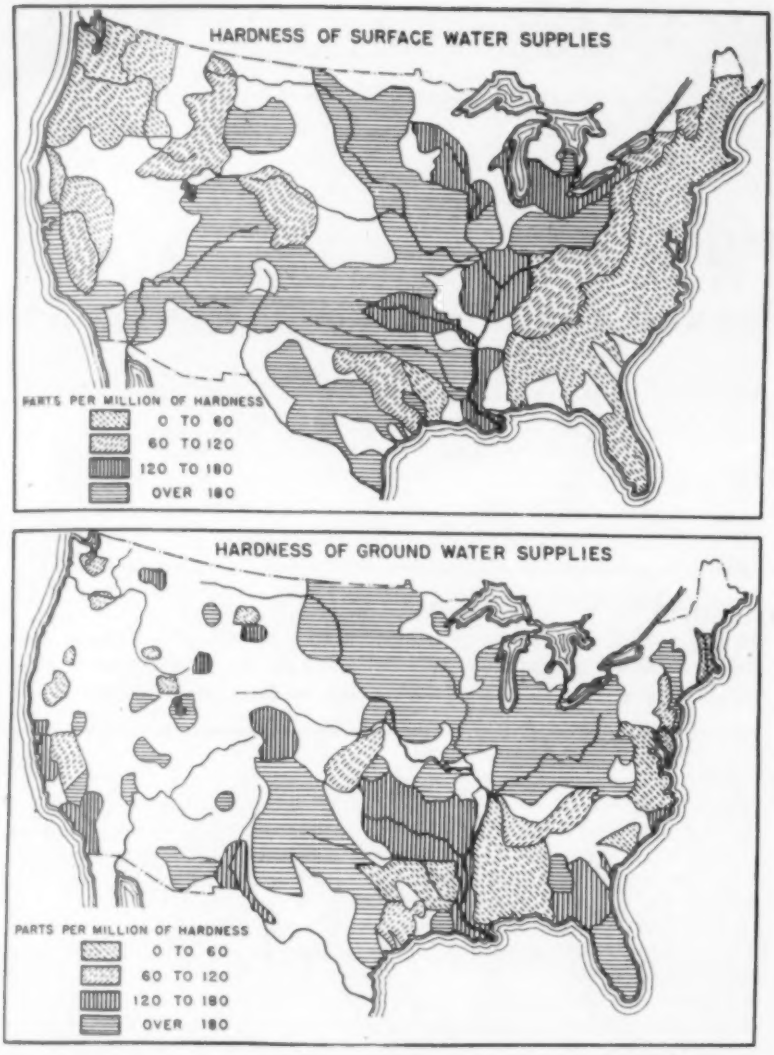


Fig. 1—HARDNESS of surface and ground water supplies in the United States, from National Resources Board "Report of Water Planning Committee" (1934)

nalysis of all of the mineral constituents dissolved in the water.

(1) If all of the non-alkali metallic cations present are accounted for and determined quantitively, the theoretical total hardness can be calculated easily as can the carbonate and non-carbonate hardness.

(2) The total hardness is calculated by multiplying the concentration of each hardness producing cation (calcium, magnesium, iron, aluminum, zinc, manganese, and strontium) by the proper factor to obtain the equivalent calcium carbonate concentration and then adding up these calculated values.

(3) Non-carbonate hardness is easily calculated by substracting the carbonate and bicarbonate alkalinity (expressed as $CaCO_3$) from the total hardness.

c. *Soap Titration* has long been used as a rapid method of determining hardness.

(1) The principle depends on the fact that when a soap solution is added to hard water, the fatty acid ions of the soap react first with and precipitate all of the calcium and magnesium, etc. before a lather (foam) is formed.

(2) By standardizing the soap solution and technique of the titration it is possible therefore to titrate the total hardness, using lather formation as the endpoint.

(3) If desired, the calcium hardness alone can be determined by adjusting the pH of the sample in the presence of ammonium chloride, before titrating. The magnesium hardness is then calculated by difference.

(4) Reference should be made to "Standard Methods for the Examination of Water, Sewage, and Industrial Wastes" for details of the technique of procedure, standardization of reagents, and corrections for interfering substances.

d. *Compleximetric Titration* is the term applied to the use of chelating agents as a means of hardness determination. The method is also termed the "EDTA Titration".

(1) The principle of the method depends on the fact that ethylenediaminetetraacetic acid and its sodium salts (EDTA) will form stable chelate complexes with metal cations.

. . . These chelates are complex compounds which hold the metal ions in solution (i.e. "tie them up") in a way that prevents them from reacting as they normally would in solution.

(2) Calcium and magnesium will also form similar complexes with certain organic dyes to form a color; Chrome Black T will form a wine red color.

(3) When EDTA is added to a hard water containing Chrome Black T, the calcium and magnesium ions are removed from the Chrome Black T complex to form the more stable EDTA complex.

. . . When all of the calcium and magnesium are extracted from the Chrome Black T complex, the solution changes color.

. . . Thus the total hardness can be titrated by using standard solutions of EDTA and the indicator Chrome Black T.

(4) Differential titration of calcium and magnesium is possible by employing variations in the basic technique.

(5) Directions for the use of the EDTA method are to be found in "Standard Methods".

B . . . Hardness Reduction

1 . . What is Softening?

a. Water softening is a process for reducing of the hardness of a water supply.

b. One method of softening is to add chemicals which will precipitate most of the calcium and magnesium salts, thereby reducing the total hardness.

(1) For this purpose, either lime alone, or lime and soda ash are added to the water in controlled amounts. This is termed the lime-soda process.

(2) As a result of this treatment, not only is the total hardness reduced, but also the total mineral content of the water is reduced.

c. A second method of softening is to substitute sodium ions for the calcium and magnesium ions in the water.

(1) In this method, hard water

containing calcium and magnesium salts is passed through a relatively inert sand-like material containing sodium ions.

(2) This material has the ability to release its sodium ions to the water and to take out of the water, the calcium and magnesium ions.

(3) This material also has the ability to reverse this action and give up calcium and magnesium ions in exchange for sodium ions when treated with a sodium chloride brine. Thus it can be regenerated for reuse, when its capacity to soften water has been used up.

(4) Inasmuch as an exchange of ions takes place, the material is termed an ion-exchange (or base-exchange) material and the process is termed ion-exchange (or base-exchange) softening. These substances have also been known as zeolites, a term which will be explained later.

(5) In the ion-exchange method of water softening, the hardness of the water is reduced practically to zero.

(6) Since two sodium ions are substituted in the water for one calcium ion, the weight of the dissolved mineral matter in the water actually increased in the process.

. . . For each 100 parts of hardness calculated as calcium carbonate, the mineral content of the water will be increased 6 parts by ion-change softening.

2 . . Reasons for Softening

a. To improve the quality of water because hard water will:

(1) Deposit scale in water heating and plumbing systems.

(2) Increase the wear on fabrics.

(3) Cause curdling of soaps and the well known bath tub ring.

(4) Require more soap or syndets to produce cleaning.

(5) Cause dryness and irritation of the human skin.

(6) Sometimes cause tastes, particularly if iron is present.

(7) Interfere with chemical processes in some industries.

b. To reduce consumer expenditures.

(1) Prior to the advent of synthetic detergents (syndets) the economics of water softening was always compared to the savings in soap resulting from the use of softened water.

. . . Studies of this subject prior to 1946 have been presented in the 2nd Ed. of the AWWA "Manual of Water Quality and Treatment." A summary of the various studies is shown in Table 1, but the data in Table 1 on dollar savings are based on a soap cost of $0.25 cents a pound rather than the 1930 to '40 values of approximately $0.16-$0.17 a pound used by the investigators during that period.

. . . On the basis of the decrease in soap use alone, it appears that municipally softened water will save consumers from $0.50 to perhaps $5.00 a year per person depending on how hard the water supply is before treatment.

(2) With the introduction and growth of syndet use, many persons predicted that the need for water softening would be lessened, but it has recently been observed that "the shift from soap to synthetic detergents did not entirely eliminate the hard water problem."

. . . A study at Purdue University and the Michigan Dept. of Health by Ringrose in 1951 determined the drawbacks of hard water, which could

TABLE I

Soap Wastage By Hard Water Per Person Per Year

Based on a Reduction in Hardness of the water to 85 mg/L

Soap Costs Estimated at .$25 per pound

Original Hardness mg/L	150	200	250	270	300	400	500	550
By Foulk's Equation[1]								
Pounds	5.7	10.0	14.5	-	18.8	27.6	36.4	
Dollars	$1.42	2.50	3.62	-	4.70	6.90	9.10	
By Snyder's Exptl. Data[2]								
Pounds				80.0				
Dollars				$20.00				
By Hudson's Community Study[3]								
Pounds					10.66			16.55
Dollars					$2.66			$4.14
By Mees' Income Group Study[4]								
Low- Pounds					3.05			
Dollars					$0.49			
Medium- Pounds					3.6			
Dollars					$0.90			
Good- Pounds					4.8			
Dollars					$1.73			
High- Pounds					6.5			
Dollars					$2.77			

(1) Foulk; Geol Surv. of Ohio, Bul. No. 29(1925)

$$S_s = \frac{K \times G \times H \times C}{1000}$$, where S_s = dollar value of soap saved per person per year; K = Foulk's constant of 0.2 lb soap loss per 1000 gal for each mg/L of soap hardness; G = gal of water softened by soap per year per person or 1.2 x 365; H = hardness removed by softening in mg/L; and C = cost of soap in $/lb.

(2) Snyder; M.S. Thesis, Ohio State University, (1927).

(3) Hudson and Buswell; Jour. AWWA 24:859(1932). This study was based on the soap buying habits and quantities actually sold at retail in four cities having different hardness in their water supplies.

(4) Mees; "Soft Water vs Hard Water", published by Guy L. Winthrop Assoc., Tallahassee, Fla. (1940). In this study, Mees not only indicated that different income groups would use different amounts of soap and water, but would also buy different grades of soap. His values for soap costs for the low, medium, good, and high income levels were $0.11; $0.17; $0.25; and $0.29 per lb respectively. In the table above, these values were equated to $0.162; $0.25; $0.361 and $0.42 per lb respectively, and the loss calculated on the basis of these costs.—The values in the table above are based on what Mees called "theoretical savings"; he indicated that the practical savings for the low, medium, good, and high income levels would be approximately 21.2%; 33.0%; 48.0%; and 56.1% respectively of the theoretical savings.

not be overcome by the use of syndets. The advantages of softened water were indicated as follows:

Item	Cost to Consumer
Fuel Use for heating water (Reduced by eliminating heat retarding scale formation)	25% less
Repairs, cleaning and replacing of plumbing. (Reduced by eliminating scale)	18% less
Replacement of fabrics (Less wear and tear in soft water)	25% less
Replacements of utensils (Less wear in soft water)	16% less
Shaving blade replacements	20% less
Scouring powder and labor to remove bathtub rings	less
Toilet soap consumption	less

(3) There are other advantages to the consumer for which the dollar value is difficult to assign, such as less water spots on dishes and silver wear after washing, etc.

. . . It has been shown many times that once a person becomes accustomed to soft water, either completely softened by ion-exchange or partially softened (to 85 to 100 mg/L) by municipal lime-soda softening, he will not be satisfied to return to the use of a hard water supply.

c. To obtain other benefits in treatment.

(1) Better coagulation is obtained in water softening plants employing lime-soda softening.

(2) Better bacterial removal is obtained in plants using lime-soda softening.

. . . Higher bacterial loading can be handled.

. . . Greater bacterial kills can be obtained at the high pH obtained.

(3) The suspended solids load on filters is reduced, and washing is reduced.

(4) The color of the water is improved.

(5) Chlorine dosage may be reduced.

(6) The amounts of coagulating chemicals may be reduced.

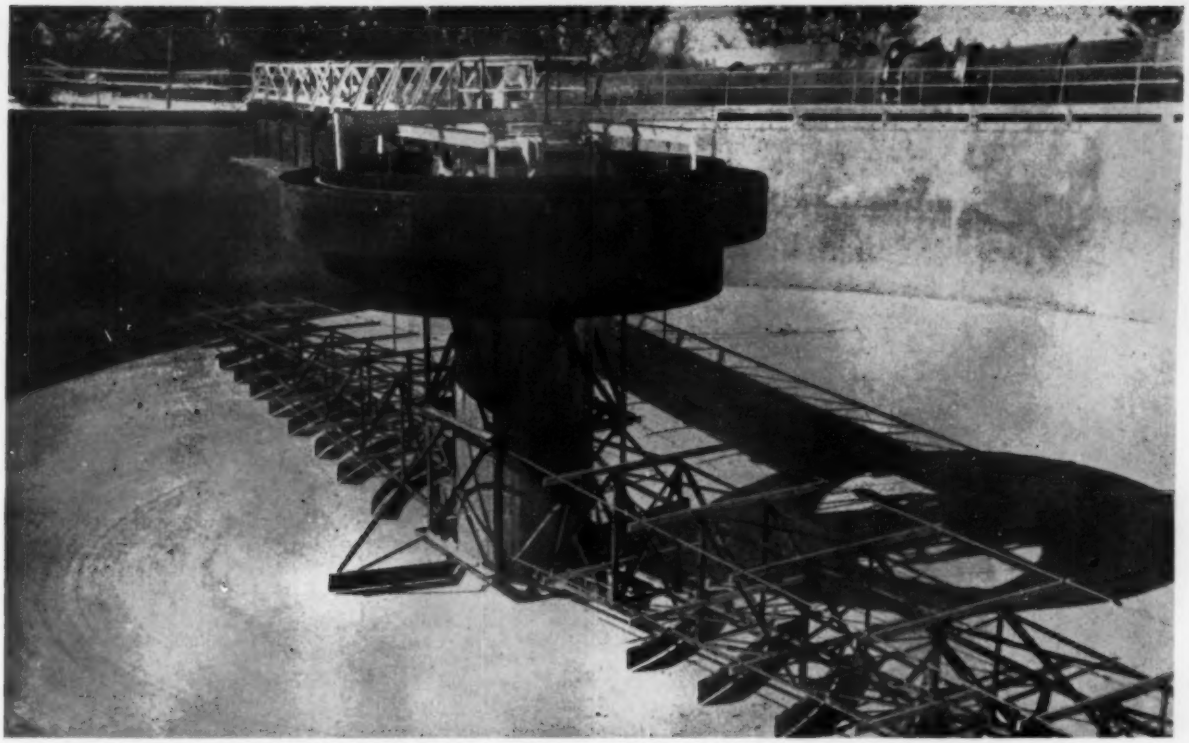
(7) Water supplies for steam boilers are improved and contain less scale forming solids and require less further treatment as well as less boiler maintenance.

(Ed. Note: The next part of this lecture will cover the details of the different types of softening processes and the economics of softening.)

Award Winning Florida Water & Sewage Plant Operators

Annually the Engineering Division of the Florida State Health Dept. makes awards to the superintendents of the best operated water and sewage plants in the state for the year previous. This year's (1957) winners of awards for 1956 maintenance and operation are here pictured. They are as follows:

Operators	Award Denoting
Front Row	
John B. Miller, Chief, Water Supply & Treatment Section, Florida State Board of Health, Jacksonville	No award
William C. Tims, Supt., Coral Gables Sewage Treatment Plant	Best operated activated sludge plant—more than 10,000 population
D. Joe Raye, Supt., Skycrest Sewage Trtm't. Plant, Clearwater	Best operated activated sludge plant—less than 10,000 population
H. B. Stroud, Supt., Myrtle Grove Subdivision Water Plant	Best operated lime-soda softening plant—serving subdivisions under 10,000 population
Sam P. Robinson, Supt., Lake Wales Sewage Treatment Plant	Best operated trickling filter plant—under 10,000 population
William M. Wright, Supt., Hollywood Sewage Treatment Plant	Best operated trickling filter plant—over 10,000 pop. (split)
Jack Whitney, Supt., West Coral Way Water and Sewage Works (Community Utilities Corp.)	Best operated primary treatment plant—under 10,000 population
Back Row	
Bob Simon, Supt., Orlando Sewage Treatment plant	Best operated sewage treatment plant—any class
L. D. Yoder, Supt., Clewiston Water Plant (US Sugar Corp.)	Best operated filtration plant—under 10,000 population
E. C. Shreve, Jr., Supt., Ocala Water Plant	Best operated lime-soda softening plant—10,000 to 25,000 pop.
William Case, Supt., Winter Haven Sewage Treatment plant	Best operated primary treatment plant—under 10,000 population
John B. Sellers, Supt., Vero Beach Water Plant	Best operated lime-soda softening plant—under 10,000 population
C. M. Courson, Supt., Tampa Sewage Treatment Plant	Best operated primary treatment plant—over 10,000 population
George Solberg, Supt., Alexander Orr Water Plant, Miami	Best operated lime-soda softening plant—over 25,000 population
W. B. Adams, Supt., Eustis Sewage Treatment Plant	Best operated trickling filter plant—under 10,000 pop. (split)
Perry Cessna, Supt., Bradenton Sewage Treatment Plant	Best operated trickling filter plant—over 10,000 pop. (split)
John W. Wakefield, Chief, Sewage & Industrial Waste Section, Florida State Board of Health, Jacksonville	No award
Edward T. Helms, Supt., Winter Haven Water Plant	Best operated primary treatment plant—under 10,000 population



ANODES on water clarifier are positioned to distribute protective current along full length of rakearms and center structure

Protection of Equipment by Effective Corrosion Control

CORROSION of submerged or buried metals is an electrochemical process resulting from electric currents passing between the metal surface and the surrounding medium. Attack occurs at the points where these currents leave the structure. Conversely, no attack occurs where the currents enter the structure. The corroding areas are anodic, the non-corroding or protected areas cathodic. The so-called corrosion currents can be galvanic in nature or can be stray currents from an external source.

Ed. Note: Mr. Meeker's paper, presented before the Illinois Section of the Am. Water Works Assn., has been released for publication in *Water & Sewage Works*.

by J. M. MEEKER
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Mechanism of Corrosion

Galvanic currents can be compared to the action of a battery, which derives its voltage from two materials of different solution potentials in contact with an electrolyte. The potential difference in a corrosion cell can result from dissimilar metals in contact, breaks in a paint film or mill scale, stresses in the metal, differential aeration, the presence of a layer of mud or sand, or other variable factors. The battery thus set up is effectively short-circuited by the structure itself, and corrosion currents are allowed to flow.

A structure under the influence of an external potential field may suffer accelerated corrosion due to stray currents. The metal structure, which usually provides the path of least resistance, will pick up current and discharge it at another point to the surrounding medium. The point of current loss is attacked, of course, in the same manner as if the current were galvanic in nature.

This type of corrosion is commonly found where the electrolyte surrounds the structure (for example, pipelines, lead cables, harbor facilities) rather

RECTIFIER unit mounted on center structure of water plant clarifier supplies protective current that flows from anodes to submerged metal surfaces of clarifier.

than where the structure surrounds or stores the electrolyte. Stray current sources include direct current railway systems, natural earth currents, welding machines, and cathodic protection rectifiers, on other buried structures. Both galvanic and stray currents carry metal ions into solution in an amount electrochemically equivalent to the magnitude of the current.

Methods of Control

The principal measures for controlling corrosion of this nature include paints and coatings, treatment of the corroding medium, corrosion-resistant materials, and the application of cathodic protection. Each has its advantages for some situations. Obviously, each has its limitations; for example, coatings cannot be 100 per cent perfect, treatment of the electrolyte is not always possible, use of materials subject to attack may be unavoidable, and physical factors may rule out cathodic protection.

Often, a combination of two or more methods applied to a given problem in the proper relationship to each other will produce the most effective and economical control system. For instance, a well-coated and wrapped buried pipeline will require only a small fraction of the protective current needed by a bare line. The capacity of the cathodic protection system designed to protect only that portion of the pipe left exposed by flaws in the coating will be correspondingly reduced, as will the installation, maintenance and operating costs.

Principles of Protection

The basic principle of cathodic protection, simply stated, is the transfer of the anodic process by which corrosion occurs to an auxiliary electrode placed in the electrolyte. The structure is made the cathode by reason of a direct current caused to flow to it through the surrounding medium. When the applied protective current superimposed upon the corrosion currents leaving the anodic areas of the structure results in a net current flow of zero, control of the corrosion is complete.

Protective current is supplied from galvanic anodes coupled directly to the structure, or is impressed through an anode system by an external direct-current power supply. The choice of methods is dictated by physical and environmental conditions, by economics, or both.

Galvanic anodes provide a driving voltage according to their position in the electrochemical series with respect to the metal to be protected. The two most commonly used materials, magnesium and zinc, exhibit a potential difference of 0.7 volt and 0.25 volt, respectively, to protected steel. The anode consumption rate is determined by the current flow and by the anode efficiency, which may be as low as 50 per cent due to impurities and self-corrosion.

Impressed current systems utilize a rectifier, a battery, or a direct-current generator to supply current to the anodes connected to the positive terminal. The negative terminal is grounded to the protected structure. Rectifiers are the most widely used power source due to their simplicity, durability, convenience, and ease of adjustment. Other sources are used where alternating-current supply is not readily available.

The anodes may be of the sacrificial or permanent type. Sacrificial anodes include aluminum and iron; platinum, graphite, and high-silicon cast iron are essentially non-sacrificial. The former are designed for a specific useful life and must be replaced at regular intervals. The permanent types represent a higher initial investment and are more subect to breakage and damage. Nevertheless, where conditions permit, their use may represent a substantial saving in maintenance costs.

The principles of cathodic protection have long been known. However, its major development has been within the last 20 years and it is steadily finding a wider acceptance and use. The facilities to which it is successfully applied include pipelines, water tanks, water and sewage treatment equipment, wells, ships, hulls and ballast tanks, condensers, traveling screens, steel piling, and others.

Limitations in Application

It is necessary to recognize the existence of limitations to the application of this method of corrosion control. These are generally imposed by the characteristics of the environment, the structure, or both. Since the fundamental theory of cathodic protection involves passage of an electrical current through a conducting medium, the soil or water must be such as to permit flow of the protective current in the required amount.

Although variations in conductivity within a reasonable range can be overcome in the design of the system, there are limits beyond which cathodic protection is neither practical nor economical. For example, it has not been successfully applied to tanks storing steam condensate, which is essentially distilled water. Also, application is considerably more difficult in some parts of the country where the water supplies are very low in dissolved solids. Fortunately, most waters and soils of a corrosive nature lend themselves favorably to the application of cathodic protection from a conductivity standpoint.

From a structural standpoint, symmetry and simplicity favor cathodic protection; complexity, shielded areas and inaccessibility work against its successful use, sometimes to the point of ruling it out entirely (for economic reasons) in favor of other control measures.

The two limiting conditions mentioned are not independent of each other; what would be a difficult de-

sign problem in a fresh water medium might be greatly simplified in sea water due to its superior conductance and the better current distribution to be expected.

Early Installations by Rule of Thumb

In the water works field by far the widest application of cathodic protection has been to water storage tanks. In the past 20 years perhaps 15,000 tanks in the United States have been placed under protection, the majority being used for some phase of public water supply.

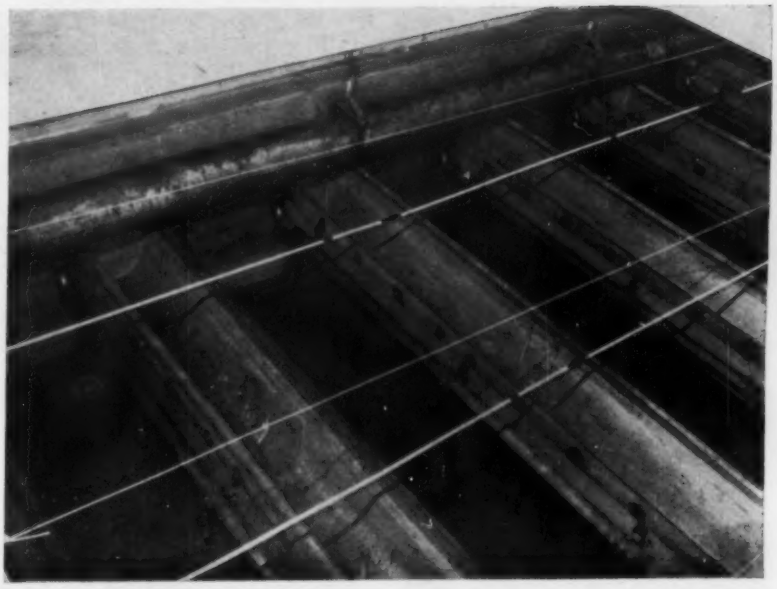
Many of the early installations were made in a more or less standard manner without regard for the many variables which should be considered in the system design. This was due for the most part to the lack of knowledge at the time and the early stage of development of the process. The result was satisfactory operation in those cases where the conditions of the job happened to match up with the equipment installed, and only partial protection in other cases. It should be realized that in the latter cases any protective current properly applied, although inadequate in amount or distribution for complete protection, had a beneficial effect in reducing corrosion.

There have been a few devices inspired by or sold under the name of cathodic protection, and using some form of electricity, which claimed to prevent corrosion or other water troubles but which in fact had no scientific basis of operation and did not accomplish the desired result. One of these so-called cathodic protection systems involved passage of direct current through an element mounted on the outside of the tank with no other result than the consumption of power. Fortunately, it is becoming increasingly difficult to market a product whose basic principles cannot be demonstrated.

Anode Materials

Most of the early water tank cathodic protection systems used mild carbon steel rods as anode material. Although this was relatively cheap, it had the disadvantages of excessive weight, causing installation and servicing difficulties. In some cases objections were raised to the anode deterioration product.

Several grades of stainless steel have been used in an effort to provide longer life. However, performance was somewhat erratic, varying from a low consumption rate up to essentially the same rate as carbon steel.



ALUMINUM anode installation for protection of filter wash piping.

Aluminum is the most commonly used anode material in water tanks and has several outstanding advantages. It is light in weight, easy to install, and available in a wide range of rod sizes. Its good machineability facilitates making up long anodes from standard lengths using threaded couplings or other means. Its rate of consumption under applied current is predictable, allowing the anodes to be designed for the desired life and arrangements to be made for regular servicing. The anode degradation product is aluminum hydroxide, which usually is not objectionable.

Permanent Anodes

Due to rising costs of anode materials and installation labor, there has been considerable effort toward the development of non-sacrificial anodes.

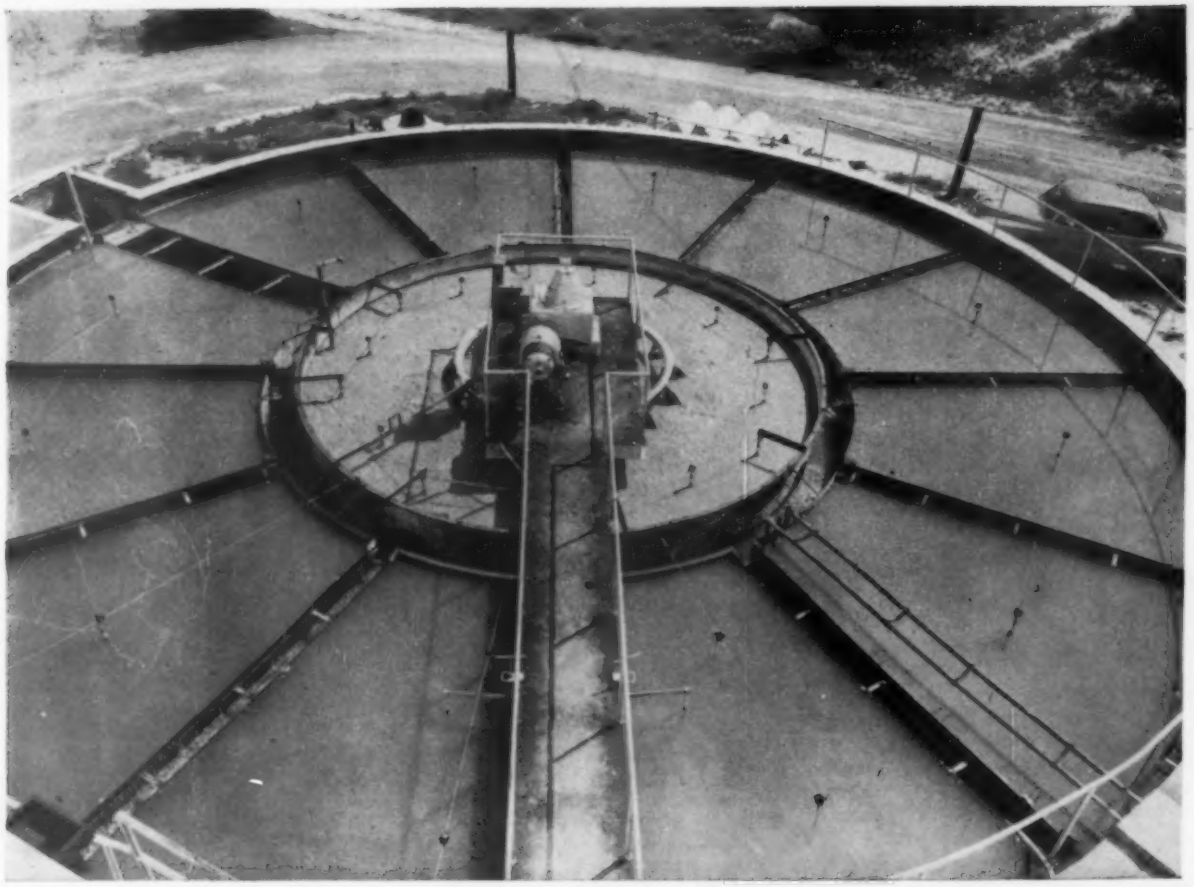
Platinum wire anodes have been used rather extensively in water tank work. Their use has become somewhat limited, however, due to several inherent disadvantages. The high cost of this material—almost $100 an ounce—requires that the anode take the form of a very fine wire. The length of anodes usually needed for tanks necessitates tying the platinum into an insulated copper feeder wire at regular intervals to prevent excessive voltage drop and current attenuation along its length. This procedure introduces the problem of attack at the joints by oxygen gas liberated by the anodic reaction. Should one or more of these joints, which are very difficult to protect from oxidation, fail in service, the copper feeder wire will deteriorate rapidly and the anode will be lost.

Graphite and 14.5 percent silicon cast iron have been rapidly developed as anode materials and are superior in many ways. New shapes and sizes allow them to be made up in almost any form required and they show very low deterioration rates under most conditions. A distinct advantage they possess over sacrificial anodes is their stable operating voltage in a given environment, as opposed to the need for constant rectifier adjustment to compensate for the increasing resistance with time of a sacrificial anode. Limitations include somewhat higher weight and a tendency toward brittleness, requiring care in handling. Also, where icing conditions occur, fall removal is required to preserve the anodes for the next corrosion season.

Anode Mounting

The most generally satisfactory method of suspending water tank anodes is from the roof plates, with a covered access opening provided at each anode location. The d-c wiring is run in conduit from the rectifier at the base of the tank to the top of the tank, and then under the roof to each anode. Most installations can be made and serviced without the necessity of anyone entering the tank.

Other water works facilities that lend themselves favorably to cathodic protection include flocculators, clarifiers, filter piping, and sludge blanket



WATER TREATMENT unit, showing anode arrangement for supplying and distributing protective current to all submerged metal surfaces.

type treating equipment. For the most part these structures are considerably more complex than tanks because of the presence of baffles, rakearms, agitators and piping. Special consideration must be given to the anode design to distribute the protective effect to the various zones which are shielded from each other. In some cases as many as four separate circuits using one or more rectifier units are required.

Additional problems are introduced by rotating equipment. For example, protection of the rakearms of a clarifier requires that the anodes be mounted directly on the arms. The current must be transferred from the rectifier to the anodes through a moving contact. This is usually accomplished by mounting a ring of heavy bare trolley wire on a rotating part of the structure and a spring-loaded shoe or brush at a stationary location.

In the case of flocculators where the entire shaft and paddle assembly rotates, the anodes are mounted on the basin wall, floor, or baffles, and the current is returned to the rectifier through a moving contact on the shaft in the dry well, or even under water if necessary.

Non-sacrificial anodes are particularly adaptable to this type of equipment for several reasons. The flexibility of the segmented type, where short lengths are assembled in strings by means of special wire and connections, improves the current distribution over extended or complex areas. The spacing between anode segments can be adjusted to suit the requirements, and the anode string can follow the form of the structure.

Taking this type of equipment out of service is often inconvenient or impossible at certain times of the year. Therefore, elimination of periodic anode replacement is most desirable. In recognition of this, non-sacrificial anodes have been used for several years under the conical portion of Accelators and Precipitators. Severe icing conditions are not usually encountered in treating equipment and the anode locations can be chosen to minimize the possibility of damage.

Evaluation of Performance

Of primary interest to owners and operators is the question of how to evaluate the performance of a cathodic protection system. The most common method is visual observation, which is often convenient but sometimes unreliable. Where protection has been applied to an old previously corroded surface, appearance alone will not always disclose whether the pits are active or inactive. This can be determined by testing the pH of the contents of the pit; active pits have a low pH, whereas a value of 9 or higher indicates corrosion has been stopped. Measurements should be made immediately after draining the water. Visual inspection is more satisfactory in a scale-forming water, since the salts plated on the tank walls by the action of the protective current are evidence of adequate protection.

Test coupons or panels have also been used quite extensively. It is usual practice to ground one to the structure so that it is included in the protective circuit, and to insulate one to serve as a control. Accurate comparisons of appearance and weight loss can then be made. There are sev-

eral disadvantages to this method which limit its usefulness. These include (a) the difficulty of producing the same surface conditions on both the panel and the protected structure, (b) the uncertainty that the panel will receive the same current density as all parts of the structure, and (c) the absence of the same stresses in the panel as are present in the structure.

From an engineering standpoint, measurement of the potential of the structure to the surrounding medium is considered the most revealing method of evaluation. It has been established that when this potential is 0.85 volts or more negative, measured with reference to a copper-copper sulfate half cell placed on the protected surface, corrosion has been reduced to zero. Another criterion sometimes used is the increasing of the negative potential of the unprotected surface by the arbitrary amount such as 0.2 or 0.3 volt.

A series of these measurements, known as a potential profile, is made over representative areas of the structure using a high-resistance voltmeter or potentiometer, with the reference electrode on the positive terminal and the tank connected to the negative. Accurate equipment and proper methods must be used to obtain meaningful results, and care should be taken to cover the critical areas of the structure. Since the response of a structure to protective current is subject to change with time, periodic rechecks are sometimes advisable.

Maintenance Required

No cathodic protection system will perform effectively unless it is maintained in continuous operation and kept in proper adjustment. Most apparent failures are attributable to a tendency to overlook this point. Perhaps this is because cathodic protection is a silent process and, in contrast to the squeaking wheel that gets the grease, causes no immediate distress upon ceasing to operate.

Generally two separate maintenance functions are required. The first is regular checking and adjustment of the current output; the second, anode replacement and minor repairs. The first, of course, must be the responsibility of the owner, while the second may be done either by the owner's personnel or by contract with an outside firm offering these services. The use of non-sacrificial anodes will reduce the frequency of adjustments and in non-icing areas will largely eliminate the need for regular servicing.

There are available several methods for automatic regulation or indication of malfunction, but they have not been sufficiently developed for general use with water tank systems. Conscientious maintenance will always be the best insurance.

Summary

In summary, it may be said that in many instances cathodic protection is the one method by which the corrosion rate can be essentially reduced to zero. The requirements for accomplishing this are provision of sufficient protective current for the particular application, provision of means to distribute the current to the surface where it is needed, and continuous and proper operation of the resulting system.

Winchester, Va. Dedicates New Filtration Plant and Pipe Line

Senator Harry F. Byrd, Jr. Makes Dedicatory Address

HONORED Citizen and Two Principals

Percy D. Miller, councilman for 24 years and 18 year chairman of the water supply committee (center); Morris Klegerman of Alexander Potter Engrs., consultants (left); Lee Grant for 20 years Winchester's City Manager and "water boy" before that (right).

Winchester, Va., was amongst the earliest, if not the very earliest of American communities to install a piped public water supply system. Wooden pipes in the system date back to 1808 and iron pipes to 1826.

On June 26, 1957 about 140 citizens and officials saw Winchester's new 7 M.G.D. Filtration Plant, and 15 miles of 24 in. cast-iron supply line from the plant to the city, dedicated. Senator Harry Flood Byrd, Jr., a "home town boy," made the dedicatory address, in which he reviewed the long history of Winchester's public water supply from limestone springs "here and there" which were connected into the system as Winchester grew.

The new supply from the famed Shenandoah River, some 15 miles upstream of the city, will serve Winchester in perpetuity and the supply is much softer than that from the limestone springs.

The new project, designed and engineered by Morris H. Klegerman of Alexander Potter Engrs. of New York City, has been built at a construction cost of $2,353,575 under the administration of Lee Grant, who has served Winchester as superintendent of water prior to his 20 year tenure as City Manager. The plant will be operated under supervision of Sam H. Reaves, superintendent of water and sewage.

The new plant known as the "Percy D. Miller Water Treatment Plant" was so named in honor of Citizen Miller who served on the Town Council for 24 years, during 18 of which he served as chairman of the water and sewage committee. It was Citizen Miller who fought hard and long for a water supply that would be softer than the now discarded limestone spring supplies and a source of water that Winchester could grow and grow on. They now have just that—a supply in perpetuity.

ONE of Pritchard, Ala. Water Works tanks
(1,000,000 gal—143 ft high—71.5 in dia.)

In many cities, elevated tanks and storage reservoirs represent the largest single investment in the water distribution system and yet maintenance and proper care thereof are sometimes postponed year after year.

Water Tank Maintenance and Cathodic Protection

by CLARENCE D. LAMON

Mr. Lamon is Manager, Water Works and Sewer Board, Prichard, Ala. In this article he gives not only excellent pointers on inspection, cleaning, preparation, and protection of water tanks, but also gives a model proposal contract, and specifications.

TODAY the care and maintenance of elevated steel tanks, standpipes and storage reservoirs are being given considerably more attention than during recent years by water works officials and city councils. In many cities they usually represent the largest single investment in the water distribution system. Yet the maintenance and proper care thereof, are sometimes postponed year after year.

Advantages of elevated storage tanks or standpipes in a distribution system may be listed as follows:

1. Reduces the size of purification facilities or the number of wells required.
2. Reduces necessary capacity of high-lift pumping equipment.
3. Reduces size of transmission mains.
4. Makes better uniform water pressure available.
5. Maintains service during interruptions in power supply or failure of equipment.

Once an elevated storage structure is built and in service, the question of maintenance arises immediately. The average life of a steel water tank structure is estimated at from 50 to 60 years. The depreciation value of a tank may be estimated from the first cost and the remaining life of the tank. For example, a $50,000 tank would depreciate about $825 annually. Even though some water works officials are not aware of annual depreciation cost, a silent destroyer daily eats away at the metal of their tanks, impairing the soundness of their investment.

*Ed. Note: This article was presented at the Water Works Short Course of Mississippi State College and released for publication in Water & Sewage Works.

This silent destroyer is rust. Eliminating the cause of rust would prolong the life of a tank. It is a well known fact that it takes water and metal to make rust and corrosion. By keeping the proper covering between the water and metal, rust is prevented from forming. Without rust there is no depreciation and the life of a tank is extended indefinitely. There is no structure which more aptly bears out the truth of the "ounce of prevention" formula than does a steel storage tank.

To assure long life and prevent the formation of deep-seated rust or corrosion, steel tanks should be given proper care. This is done by thoroughly inspecting both the inside and outside at intervals not exceeding two or three years, depending on the operating conditions and experience factors of the particular utility.

The Water Tank "Racket"

In some cities and towns the municipal government and the water works officials frequently change during the interval between one tank painting job and the next. All records and the valuable experience gained in one cleaning and painting job may be lost and be of no assistance in contemplating a future painting job.

Most water works officials are now generally aware of fraudulent practices of some unscrupulous tank maintenance companies soliciting tank painting and repair work. The high-pressure salesmen of these unscrupulous or fly-by-night firms start working on a water tank owner by claiming that they are just passing through town, and being interested in water tank maintenance observed the dangerous condition of their tank. They also may pretend that they have looked over the tank, noticed signs of leakage, observed that the sway rods were loose, and urge that the tank should be repaired and painted immediately to protect the metal before it gets worse, or before the tank blows over from heavy winds.

These firms mostly operate in towns under 10,000 population. Their representative or contact men generally have with them and present their own form of contract. They have several type forms, all worded for their advantages, usually very loosely, with guarantees that are not specific and are worthless as far as enforcement is concerned. They will also present the type of contract they think they can induce the owner to sign immediately, without giving him adequate time to thoroughly examine it or time to have it appoved by a legal advisor.

If a water tank reaches 20 years of age and it is suspected that regular inspection and maintenance of the tank has not been of the best, it is advisable to have a complete inspection made.

Usually the contract has a clause or statement that "the contract is void if not executed within twenty-four hours".

One of these forms of contract provides for the owner to furnish all materials. Another form provides for the contracting firm to furnish all materials, and they will claim that their materials meet or excel government specifications. However, the materials are generally of the lowest grade. In either form of contract that these firms present the contracting firm furnishes all labor and equipment for cleaning, repairing and painting the tank. Generally found in the fine print is a clause stating that the equipment such as air compressors, welding machines, and pneumatic tools, if needed, will be charged for at so much per hour; loose rivets will be replaced at so much each; and electric welding of pits and seams will be charged for at so much per square inch. When such an agreement is signed, it appears that this part of the contract work is merely incidental to the cleaning and painting, so as to put the tank in first class condition at what looks like a bargain price.

After one of these contractors goes to work, however, and the tank has been emptied for cleaning and painting, troubles start. They claim that they discover loose rivets that need replacing, seams and pits that need welding, and that the saucer and spider rods need extensive repair or replacing. All of this type of work was mentioned in the fine print of the contract, but was merely incidental before signing. When the work is completed the tank job has cost several times the amount proposed in the beginning; and two or three times more than a reliable responsible tank construction and repair company would have charged to put the tank in first-class condition.

Inspection

If a water tank reaches 20 years of age or more, and it is suspected that regular inspection and maintenance on the tank has not been of the best, it is advisable to have a complete inspection made. Or if a water tank structure has been neglected and it is evident that it needs some repairs before painting, the owner should know definitely what kind of paint job is needed and what repairs are necessary before he enters into a contract to have work done.

On the basis of experience, a schedule for cleaning and painting the tank at proper intervals should be set up. A short time before the tank is to be overhauled, it should be examined. If the owner does not have someone in the organization who is capable of inspecting the tank, then some capable and competent expert not involved with a contractor or interested in the profit to be made should be consulted. Usually the tank manufacturer has experienced men for this service. For a normal charge they will submit a written report showing the condition of all parts of the structure. Be prepared, however, to empty the tank for the inspection, as this is the only accurate and complete way the interior can be inspected.

With a complete independent report on the structure, a proper form of contract can then be drawn up, together with specifications suitable for the performance of the required work. The American Water Works Association has standard specifications and recommended practices for elevated steel water tanks, standpipes, and reservoirs; painting and repainting such structures are included. "Pamphlet No. 102-53" contains recommended procedures and a list of coatings, based on experience gathered from reliable sources, for both the interior and exterior surfaces, that have been proven satisfactory

Cleaning and Preparation

More important than the application of paint, is the preparation of the metal surface before paint is applied. Underwater exposure involves very severe service for paint on the interior. As water is consumed daily, the metal is also exposed to the humidity of the air. The exterior is exposed to the hot baking sun, wind, rain, hail and snow, and in some localities the gases of smoke and fumes from industrial plants, as well as salt air along the sea coast.

The interior and exterior surfaces of water tanks or standpipes are each cleaned and painted in a similar manner. However, on each surface all rust scale, old paint scale, blisters, loose rust, dirt and any other foreign matter must be removed before applying any new covering on the metal. The same tools are generally used on in-

SUGGESTED PROPOSAL, CONTRACT AND SPECIFICATIONS

For the Cleaning, Painting and Repairing of Steel Water Storage Tanks

General Conditions and Instructions to Bidders

Sealed proposals will be received by the ...., at ..... until ..... o'clock on ....., for furnishing all labor, materials and equipment necessary and required to thoroughly clean and paint both the exterior and interior surfaces of the ....gallon steel water storage tank located on..... ....., all in accordance with the contract and specifications covering this work.

Bidders must secure their information as to the conditions of the tank and all local conditions effecting the work prior to submitting their proposal.

Work must be begun promptly after the award of the contract and within such time as stated by the successful bidder, and be completed by the time named by said bidder.

Bidders are notified that the price bid must include everything described in the specifications. No extras of any kind will be allowed unless ordered in writing by the ....

The bidder must satisfy the Company of his practical and financial ability to perform the work bid upon. The bidder must attach to his proposal the names of the owners of three structures, of the same type, for which the bidder has successfully completed work of the nature outlined in the attached specifications, within the last 12 months.

Payment for this work will be made in cash, and in accordance with the contract and specifications.

The right is reserved to reject any or all bids or to accept any bid considered advantageous to the owner.

Proposal

..... (Date)

To .....:

We hereby propose to furnish all labor, materials and equipment necessary and required to throughly clean and paint both the exterior and the interior surfaces of the steel water storage tank located on ....., all in accordance with the general conditions, contract and specifications, which we have examined, for the lump sum of ..... $.....

If awarded the contract, we will begin work ..... days after receiving notice of the award, and will complete said work within ..... calendar days after receiving notice of the award.

Respectfully submitted,

.....

.....

Specifications

Definition

Whenever the word "Owner" is used, it shall be held to mean the ....., its Superintendent, Engineer or other authorized agent. Whenever the work "Contractor" is used, it shall be held to mean the Contractor or Firm under contract to do the work herein specified.

Suspension of Work

The Superintendent, or Engineer, or authorized Agent, of the owner shall have the right to stop or suspend the work at certain points if in his opinion public need demands it. In case of any suspension, the time within which the Contractor is required to complete the work shall be extended by as many days as the same was thus suspended.

Alteration

Any alterations or modifications of this work here contracted for shall be made only by a written agreement between the Superintendent, Engineer, or authorized agent and the Contractor before the alterations or modifications have been started.

Extra Work and Material

No claims for any extra work or materials will be allowed, unless it is ordered in writing by the owner and the price to be paid is agreed upon by a written agreement before the work is done or material furnished.

Compensation Insurance

The Contractor shall provide adequate workmen's compensation insurance for all labor employed by him on the project, and shall comply with the Workmen's Compensation Laws of the State of ....., and shall give proof of such insurance, satisfactory to the owner.

Public Liability Insurance

The Contractor shall promptly protect the work, and shall hold the owner harmless from all damages occurring in any way by his acts or neglect, or that of his agents, employees or workmen, or for damages due to injury to his employees, or others during the progress of the work. He will also be required to furnish a certificate of insurance showing the Contractor to have a policy of not less than $10,000 covering property and public liability. He will also defend in court by his own counsel any suit brought against the ..... for any property damage or personal liability in connection with the work covered by this contract and outlined in the specifications.

The Contractor is hereby cautioned to exercise precaution in protecting all property owned by the Company or adjacent thereto during the progress of his work.

Payment

Payment will be made in cash upon completion of work following inspection and acceptance of the work by the Company.

Inspection of Work

The work shall at all times be subject to inspection, but such inspection shall not relieve the Contractor from any obligation to perform said work in accordance with the specifications or any modifications thereof, as herein provided, and work not done strictly in accordance with the specifications shall be corrected and made good by the Contractor whenever so ordered by the Superintendent, Engineer or authorized agent of the owner, without reference to any previous oversight or error in inspection.

Preparation of Surfaces—Exterior and Interior

If the old paint is in good condition, adheres tightly to the steel, and is hard and not too thick, it may be left on. All rust, loose mill scale and loose paint shall be removed by means of scalers or scrapers and wire brushes (preferably power driven), emery cloth or sandpaper. Special care shall be used to clean all pits and roughened areas. In places where blisters or rust has occurred, the steel shall be cleaned until it is bright, either by wire brushes and scrapers or by the use of hand or power sanders. All foreign material, rust and loose paint shall be removed, and any old paint which has been allowed to remain shall have a clean surface and be tight to the steel.

All rust, scale and sediment collected inside of the tank bottom shall be entirely removed from the tank and the inside surfaces swept clean. In cleaning elevated tanks, such rust, scale, etc., shall be lowered to the ground by acceptable means and disposed of in a manner satisfactory to the owner.

Paint shall not be applied when the temperature is below 40° F. The surface shall be free of frost or dampness when paint is applied. No paint shall be applied unless good weather prevails, nor such applications be started if inclement weather threatens.

All paint shall be evenly spread and throughly brushed out. The highest standards of workmanship shall prevail. In all instances, the application of paint shall be satisfactory to the en-

gineer-in-charge or to the inspector delegated by him. Particular attention shall be given to rivet heads, edges, welds, etc.

Workmanship

The paint shall be of the proper consistency for a brush application. Thinner shall not be added under normal conditions. In the cooler weather it may be necessary to thin the paint. If so, not more than one pint per gallon shall be added. For a spray application, thinner may be required for the paint to pass through the spray equipment. Only enough thinner shall be added to permit the paint to pass through the spray equipment. In no case shall it exceed one pint of thinner. "Mineral Spirits" is the suggested thinner, when required.

Repairs

It shall be the duty and responsibility of the contractor to notify the owner of any loose rivets, open seams, etc., before the application of paint so that the owner can make the necessary repairs with his own employees, or to authorize the contractor in writing to proceed with this work at a total price agreed upon in writing.

Sanitary Requirements

The contractor and all workmen employed by him shall conduct all operations in a clean and sanitary manner. No nuisance shall be committed in a tank; the workmen shall either use proper waste receptacles or leave the tank whenever necessity arises.

The tank owner, after work of any nature is done in a tank, is charged with satisfying himself that the tank interior is clean and sanitary before the tank is returned to service. Although a contractor may be required by his contract to clean all painted surfaces thoroughly before a tank is restored to service, it is the ultimate responsibility of the tank owner to give the tank a final field inspection or to require such laboratory tests of the quality of water held (for test purposes) in the tank as will demonstrate the good sanitary condition of the tank interior.

Inspection

The owner shall inspect the painting as it is being done or employ an inspector to do so. Payment for painting shall be made only after the owner has satisfied himself directly that the painting is satisfactory; or after an inspector's report has been filed with the owner certifying that the painting has been done properly and in accordance with the requirements of the contract.

It is in the mutual interest of the owner and the contractor that such inspection be made promptly.

Ventilation

The contractor must provide adequate ventilation while painting the interior surface of a tank. The ventilation shall be adequate to remove fumes and prevent injury to workmen or the possibility of accumulating volatile gases.

Paint

Paint shall be delivered to the job site in factory-sealed containers, with the manufacturer's labels affixed to the containers showing the manufacturer's name, brand, color, identification number, etc.

The paints used shall be recognized as being suitable for the protection of water storage equipment. If required by the owner, the contractor shall furnish the owner with a list of 5 water tanks painted with the paints the contractor proposes to use, from which not less than 6 years' protection was secured on water tanks.

If the paint used has a graphite pigment, which is preferred, only the use of natural flake silica graphite will be permitted.

Exterior

Prime Coat: .....
.....
Intermediate Coat: .....
.....
Finish Coat: .....
.....

Interior

Prime Coat: .....
.....
Intermediate Coat: .....
.....
Finish Coat: .....

Contract

This Contract, entered into this ..... day of .... 19, by and between the ..... and .... Contractor, for furnishing labor, materials and equipment necessary and required to thoroughly clean and paint the interior surfaces of the steel water storage tank located on ..... for the consideration of .... Dollars ($ .....) in strict accordance with the requirements of the accompanying specifications which are made a part hereof.

Witnesseth, that the said Contractor has agreed and by these presents does agree with the ..... for the consideration named, to furnish all labor, materials, and equipment and do all the work of whatever nature necessary to complete in a workmanlike manner and according to the specifications and subject to all the terms and to the approval of the ....

In case the Contractor shall be required to do any work of a class not provided for in the bid and this contract, said Contractor agrees that the amount to be allowed him shall be fixed by written agreement between the said Contractor and the .....before the work is commenced, and in case of failure to agree, then by some party to be agreed upon by said ..... and the Contractor.

That said Contractor agrees that the Superintendent, Engineer or other authorized agent of the ..... may cause any work or materials not in accordance with the specifications and the contract to be replaced at the expense of the contractor.

The ..... agrees and binds itself upon the completion of the work to the approval of the Superintendent, Engineer, or other authorized agent to pay to said Contractor the amount of money due under this agreement. Full payment will be made upon the acceptance of the work.

Form of Bond

KNOW ALL MEN BY THESE PRESENTS: That .... as Principal, and ..... as Sureties, are held and firmly bound unto the ..... of ....., in the sum of ..... Dollars, for the payment of which, well and truly to be made, we do hereby severally bind ourselves our heirs, executors, and administrators, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that, whereas the said above-named principal did on the .... day of ..... 19 ....., enter into the foregoing agreement is made a part of this bond, the same as though fully set forth herein:

NOW, if the said Contractor in the said foregoing statement shall well and truly execute all and singular the stipulations of said agreement by him to be executed, and shall pay all just and legal claims for labor performed upon and for materials furnished for the work specified in said agreement, then this obligation to be void, otherwise to remain in full force and virtue in law; we agreeing and hereby consenting that this undertaking shall be for the use of any laborer or material men having a just claim as aforesaid, as well as for the ....., and further, that the parties to the foregoing agreement may, from time to time, and as often as they see fit, make any additions to, ommissions from, or modifications of the work and the said agreement, which in the judgment of said parties do not materially increase the liability thereon, without consulting the Sureties hereto, and without in any way affecting their liability hereon.

WITNESS OUR SIGNATURES, this ..... day of ..... 19...

.....
Contractor

.....

Signed in the presence of:

.....

.....

.....
Surety

IN WITNESS WHEREOF, the said ....., of ...., has caused to be hereunto affixed its corporate name and seal by its ..... attested by its ...., and the said Contractor has hereunto set his hand and seal this ..... day of ..... A.D., 195...

.....

.....(Seal)

In Presence of:

.....

.....

.....
(Company Name)

.....
(Title)

By .....
(Title)

terior and exterior. They are: hand scrapers, wire brushes, power scalers, power wire brushes, and flame cleaning and sand blasting equipment. Flame cleaning or sand blasting do a thorough job of cleaning all metals. These processes are quite expensive and are not included in the standard cleaning of a tank, unless they are particularly specified and the job is priced to include this type of metal cleaning and preparation.

There is a great difference in the chemical properties of both surface and ground waters in various parts of the country. Frequently, a paint that would resist the action of water in one locality would deteriorate very rapidly under the action of water in some other locality. Theoretically, any coating of paint or other substance that will keep water from contact with metal will prevent rusting.

Painting should follow as soon as possible after cleaning. Under normal mild atmospheric conditions it is best to prime all exposed bare metal surfaces within eight hours after cleaning, to prevent further rusting.

Tank Interior

Experience has shown that in practically all cases the inside surfaces of a water tank are in worse condition than the outside. Almost without exception, tank bottoms which have to be replaced on account of leaks through the steel have corroded through from the inside. This is due to neglect of cleaning out accumulated mud. It is vitally important that the inside of a tank be painted as often as the outside; if the water is corrosive, the inside may have to be painted at more frequent intervals.

When the old paint is in fair condition, only one coat may be required; after cleaning, however, certain portions of the steel will be bare. These bare spots should be painted with a patch coat of a good rust inhibitive paint before the finish coat is applied. If the surface is generally in bad condition, a complete primer coat should be applied instead of patch coating. The first coat must be thoroughly dry and hard before the second coat is applied. The same holds true with the last coating before the tank is again filled with water.

Red lead and linseed oil paint in general has given good results for this service. Asphalt paints have been found suitable for some waters, but quite unsuitable for others. Coal tar enamels also have been used and have given satisfactory results. More recently, the newly developed synthetic resin type of paint has given very good results under many conditions. In the event that two coats of paint are necessary, when using other than asphalt or coal tar enamels, a small amount of lampblack should be added to the second coat to give it a darker shade. This makes it easier to determine whether the first coat has been entirely covered by the second coat.

For many years grease coatings have been used for the interior protection of elevated tanks and standpipes. Experience has proven that a rustproof grease compound applied to steel tanks will prevent water from coming in contact with the metal in most cases for about five years or more. The advantage in using a grease compound is that a tank can be returned to service immediately after it is applied. Another advantage lies in the fact that interior and exterior work on a tank can be performed simultaneously. Still another great advantage lies in its low material cost and low labor cost for application. Yet the tank will have adequate metal protection as long or longer than other metal coverings, especially if a good prime coat is applied to new steel ahead of the grease coating.

Whenever the storage structure is emptied and entered for inspection, cleaning and painting, or for any other purpose, it should be disinfected by a standard recognized method before it is placed back in service.

Exterior

Exterior surfaces of elevated tanks and standpipes are subject to constant exposure to general weather conditions. To secure a first class appearance and durable job requires more skill than is needed for the interior.

All exterior metal must be carefully cleaned. Then if the tank is in a very run down condition and cleaning has removed a large portion of the paint, it is economical to apply a complete coat of rust inhibitive primer, regardless of what kind of color or finish coat is later applied. Should the surface be in fair condition, and only small areas of bare metal have been exposed by cleaning, it is economical to patch coat the tank.

If the old paint on the outside of the tank is dark and a light coat is desired, it will be necessary to apply

The American Water Works Association has standard specifications and recommended practices for elevated steel water tanks, standpipes and resrvoirs; painting and repainting such structures are included.

two finish coats, as light paints do not have as good hiding power as dark paints. The second coat should be darkened by the addition of lampblack, so that all areas may be successfully covered.

No finish coat should ever be applied over bare metal, especially when using aluminum paint, because a stain or yellowing by rust will show through within a few short months. Yet when aluminum is properly applied over a prime coat or over good patch coating, a highly satisfactory job is secured. The finish coat is more or less confined to the use of aluminum paint as about 95 per cent of all tanks and standpipes are now completed in aluminum. No particular skill is required for a dark or black graphite finish coat, except in being careful that brush marks are not noticeable. In using aluminum paint, every slight imperfection, every fault in workmanship, even irregular mixing, shows up glaringly. If only one coat is applied over old paint that has been patch coated with a rust inhibitive paint, the finish coat will have a somewhat mottled appearance, with some areas being slightly dull and other areas having high brilliance and luster. Generally, after about 60 days the aluminum paint will bleach to about the same appearance.

More important than the application of paint, is the preparation of the metal surface before paint is applied.

Cathodic Protection

During the past 10 or 15 years water works engineers and water works officials have given considerable study to corrosion losses in steel water structures and methods whereby it may be eliminated, or at least retarded. For this reason, substantial progress has been made in perfecting effective and economical protection to prevent internal corrosion in steel water structures by emplbying cathodic protection systems.

The theory of cathodic protection is relatively simple. The system consists primarily of a source of direct current, and necessary electrical wiring for connecting an anode system to provide adequate current density to maintain and distribute current to all parts of a steel structure that is in contact with water. The power unit or rectifier reduces and converts 110-volt alternating current to a more favorable direct current of 6 volts or more. The electric circuit is completed by using the steel structure as a conductor to return the current to the negative terminal of the rectifier. In operation, direct current flows from the rectifier into the anodes and then through the water to the metal surfaces of the tank.

The value of cathodic protection depends entirely upon a correctly designed anode system. Anodes generally used in most water tanks are made from aluminum and magnesium, because this material is mechanically strong, with ample tendency to resist deterioration when current is flowing from its surface. It is also less expensive than other anode materials.

For a cathodic protection system to accomplish its purpose in a steel water tank, the anodes must be correctly positioned, and adequate in number, diameter and length to properly distribute current to all parts of the tank in contact with water. Due to these facts, when contemplating an installation it is advisable to consult reliable manufacturers with skilled engineers who will analyze each individual factor of the particular job requirements.

After a properly designed system has been in operation for several months, a white chalky film will form on the bare metal beneath the rust or corrosion. This chalky film, being mainly calcium carbonate from the water, turns the surface of the metal to clean gray steel. The coating gradually increases and retains the same appearance as long as the system is properly maintained. It also is advisable to employ a reliable company with trained and competent service crews for maintaining the system to assure efficient and dependable protection. This can be done on an annual basis for a nominal charge.

These systems are being used quite extensively and have proven to be dependable. However, they must be of ample size, properly installed, and properly maintained to produce the desired results. They will only protect the area of the tank interior where the water is in direct contact with the metal. They will not protect the area of the tank above the water line, or that area of or near the bottom that is usually covered by silt, debris and sand of varying depth, unless this is moved before installation of the system.

Whenever a storage tank is emptied and entered for inspection, cleaning and painting, or for any other purpose, the tank should be disinfected by a standard recognized method before it is placed back in service.

Summary

Whenever a utility or other tank owner feels that work is needed to properly repair or paint a water storage structure, complete knowledge should be gathered as to just what work needs to be done, what materials are to be used, the manner in which the work is to be performed, and the cost, before contracting with any firm for such work. The greatest security that a tank owner can have in the performance of such work is that comprehensive liability and workmen's compensation insurance is carried on each contact. For the performance of the work demand a corporate bond, not an individual bond. Use care in selecting a contracting company. If an honest reliable contractor is selected, most of your duties and worries are over before the work is started.

Purdue Industrial Waste Conf. Proceedings Now Available

Proceedings of the 11th (1956) Purdue Industrial Waste Conference, edited by Don E. Bloodgood, Prof. of San. Eng., is now available.

All who registered at the 1956 Conference will receive a copy free of charge. Others may purchase copies of the Proceedings by sending $2.50 per copy to the office of R. N. Woerner, Engineering Administration Building, Purdue University, Lafayette, Indiana. Checks should be made payable to Purdue University.

LOOKS like another man just quit the Company.

Rubber-Seated Butterfly Valves

Part 1—How to Select the Proper Size

by A. E. HATCH, Jr. and W. H. CHAMBERLAIN

Mr. Hatch is a Sales Engineer and Mr. Chamberlain a Development Engineer of Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I.

This is the first of two articles* which present information and data of fundamental character and of importance to users of butterfly valves.

DURING recent years, municipal and industrial water, sewage and waste treatment plants have been benefiting from the unique design features of rubber-seated, tight-closing butterfly valves. Among the basic characteristics contributing toward their wider acceptance and increased use on control and open-shut service are:

1. A uniformly changing coefficient of flow versus degree of opening.
2. Low head loss when in wide open position.
3. Bubble-tight shut-off.

The intent of this article is to aid potential users in selecting the proper size valve to provide optimum service for a particular installation. All data and formulas presented here are based on numerous tests conducted over many years, and apply specifically to butterfly valves *used with liquids*. This information is also applicable to gases and vapors if the pressure drop through the valve does not exceed approximately one-fourth the absolute pressure.

The curves included with this article are based on 90° seated butterfly valves.

*(Ed. Note: In a companion article to appear in an early issue, the authors will discuss methods of determining torque requirements of butterfly valves.)

Flow Control and Head Loss

In order to visualize the control characteristics of a butterfly valve, first consider the typical system shown in Fig. 1 and the head loss equation:

$$\Delta H_o = (C_p + f\frac{L}{D} + 1)\frac{V^2}{2g}$$

$$= (C_p + K)\frac{V^2}{2g} \qquad \text{Eq. 1}$$

(Note—the digit 1 in the above equation has been included to cover discharge loss which occurs in any system without a recovery cone at the point of discharge. Often this loss is neglegible compared to pipe friction but when this equation is applied to very short pipe runs, the discharge loss plays a significant part in limiting the maximum velocity)

For the sake of convenience in applying Equation 1, the equivalent pipe friction and the discharge loss are combined into one system loss coefficient, K. The butterfly valve loss coefficient, C_p, is taken from Fig. 2 for any given disc angle.

Actual velocity and flow rate, with the valve in the system, can be calculated by using Equations 2 and 3 (developed directly from Equation 1):

$$V = \sqrt{\frac{2g\Delta H_o}{C_p + K}} \qquad \text{Eq. 2}$$

$$Q = 352.5\ D^2\sqrt{\frac{2g\Delta H_o}{C_p + K}} \qquad \text{Eq. 3}$$

The flow control characteristics for a butterfly valve can be presented in the form of a set of curves (see Fig. 3) where

$$\frac{100 \times Q}{Q_{max}}$$

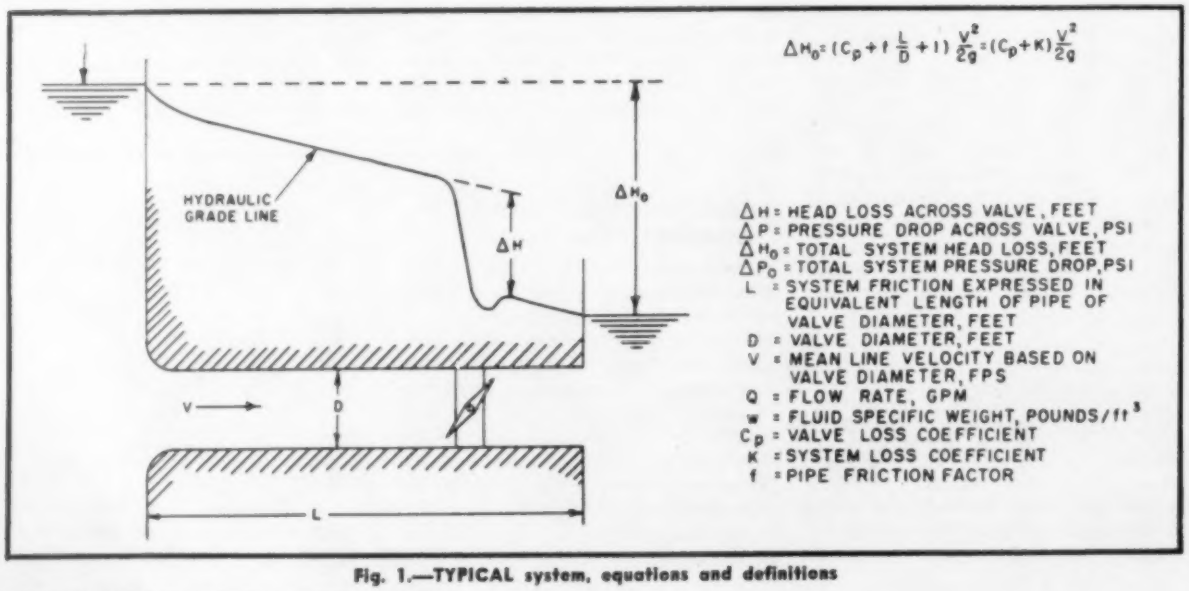

$\Delta H_o = (C_p + f\frac{L}{D} + 1)\frac{V^2}{2g} = (C_p + K)\frac{V^2}{2g}$
HYDRAULIC GRADE LINE
ΔH
ΔH_o
V
D
L
ΔH = HEAD LOSS ACROSS VALVE, FEET
ΔP = PRESSURE DROP ACROSS VALVE, PSI
ΔH_o = TOTAL SYSTEM HEAD LOSS, FEET
ΔP_o = TOTAL SYSTEM PRESSURE DROP, PSI
L = SYSTEM FRICTION EXPRESSED IN EQUIVALENT LENGTH OF PIPE OF VALVE DIAMETER, FEET
D = VALVE DIAMETER, FEET
V = MEAN LINE VELOCITY BASED ON VALVE DIAMETER, FPS
Q = FLOW RATE, GPM
w = FLUID SPECIFIC WEIGHT, POUNDS/ft^3
C_p = VALVE LOSS COEFFICIENT
K = SYSTEM LOSS COEFFICIENT
f = PIPE FRICTION FACTOR

Fig. 1.—TYPICAL system, equations and definitions

is plotted against α:

Where

Q is the flow rate for the valve position.

Q_{max} is the flow rate for the valve fully open.

α is the angular position of the vane measured from the closed position.

The curves show, for various values of K, the percent of maximum flow rate that is achieved at each valve angle. Note that although Q varies with the system supply pressure (for a given angle of opening), the ratio Q/Q_{max} does not.

The curves in Fig. 3 also can be used where the valve diameter is less than the line diameter; however, in this event the coefficient K must be computed as:

$$K = \frac{(\text{Valve diameter})^4}{(\text{Lime diameter})^4} K_{line} \quad \text{Eq. 4}$$

Where K_{line} is the coefficient for the system in which valve and line diameters are the same. Note, for example, that reduction of the valve size to about 7/10 line diameter reduces the coefficient K to one-fourth its original value.

Selecting Proper Valve Size

For a fluid with a specific gravity of 1.0, the relations between pressure drop, disc angle, velocity, valve size and flow rate are given in the nomograph, Fig. 4. This nomograph can be used for other fluids with a specific gravity other than 1 by multiplying the "as read" pressure by the specific gravity of the fluid.

An example of the use of the nomograph is shown by the dotted line. Note that two separate relations are shown, with velocity as the common variable. The relation between flow rate, valve diameter and velocity expresses the continuity of flow and does not depend on valve characteristics. The relation between pressure drop, disc angle and velocity introduces the valve characteristics in the form of the pressure loss coefficient Cp, as shown in the following equations:

$$\Delta H = C_p \frac{V^2}{2g} \quad \text{Eq. 5}$$

$$\Delta P = C_p \frac{W V^2}{(144)2g} \quad \text{Eq. 6}$$

The variation of C_p with disc angle is shown in Fig. 2, previously mentioned.

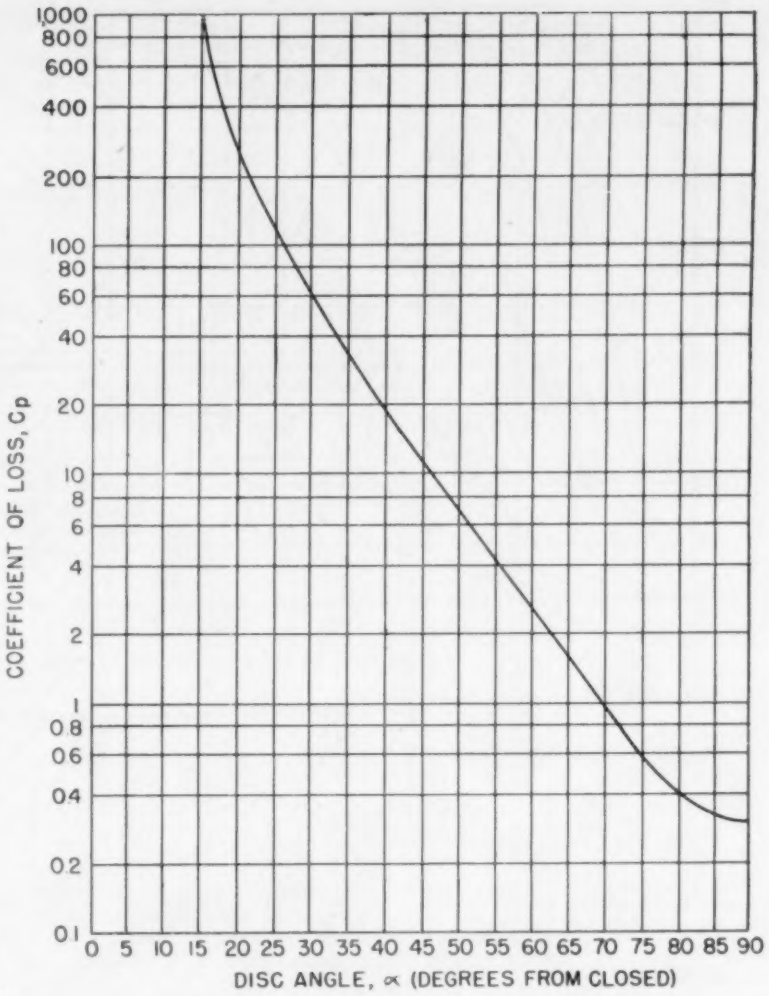


Fig. 2—BUTTERFLY valve loss coefficients

Rules of Thumb For Valve Size Selection For Control

1. In choosing a valve for best control characteristics, select the diameter that gives a maximum velocity of 16 ft/sec. when the valve is fully open. For systems with relatively high friction, Q_{max} does not change greatly even for large changes in valve diameter. For such systems, the nomograph (Fig. 4) can be used to find the size of the valve that will give a maximum velocity of 16 ft/sec.

If the result means an unusually large neckdown ratio (ratio of line diameter to valve diameter), the head loss for a wide-open valve can easily be checked by continuing to the upper portion of the nomograph and reading the pressure drop at 90°. Comparison of this figure with the total system loss will indicate whether the losses are too high.

2. Start with a valve loss at maximum flow of about ten percent of the fixed system losses, then work from there to the valve diameter.

For accurate results, the added losses caused by the reducers in a necked-down valve installation should be accounted for by using a value of C_p somewhat greater than 0.3 for the fully open valve. This increase in C_p depends upon both the neckdown ratio and the reducer cone taper, but in normal installations it will not exceed a valve of 1.0 even for abruptly tapered cones. Normally, this resistance is negligible compared to system friction.

In Fig. 1, a definite pressure recovery is shown to result from the velocity issuing from the valve. If the pipe downstream of the valve is too short or otherwise arranged so that it does not flow full, this recovery of pressure will not occur and C_p will have a valve of 1.0 for free discharge through a fully open valve.

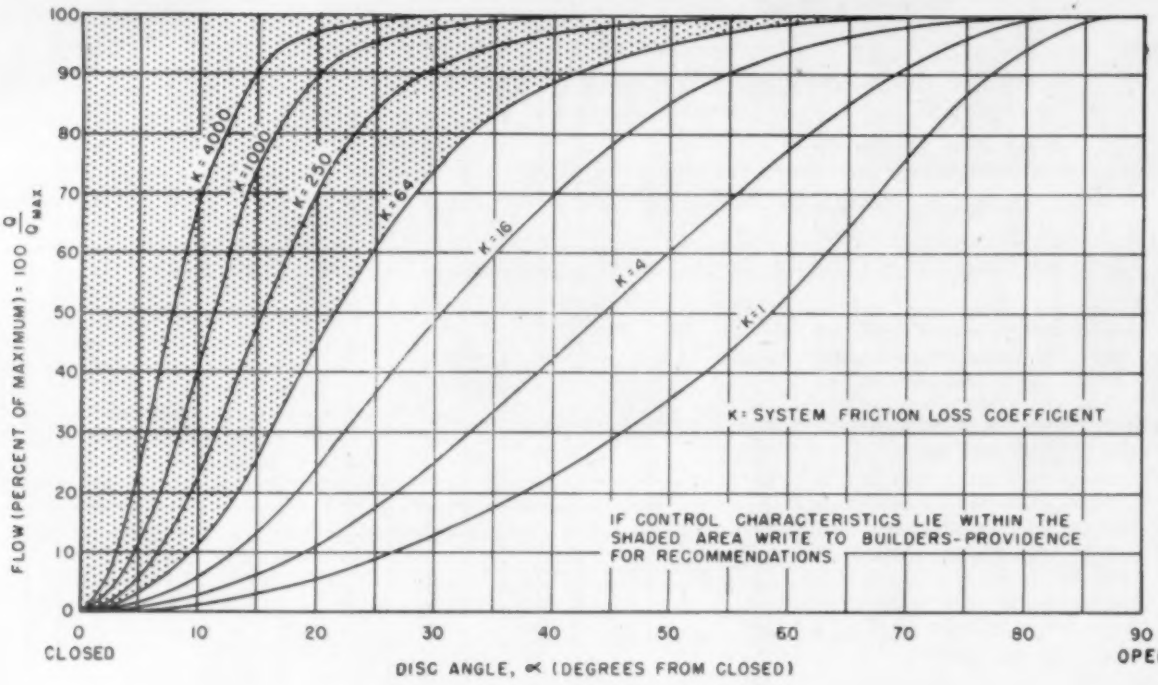


Fig. 3—BUTTERFLY valve control characteristics

Note: This value of 1.0 is in addition to the value of 1.0 already introduced to account for pipe discharge loss.

Sample Problem of Selecting Valve Size

For this example, we will select a problem typical of the water treatment plant influent basin level control when supplied by gravity from a reservoir several miles away. Assume that the reservoir level is 62 feet above the influent basin and the supply line is a 36 in. pipe 7 miles long, with a friction factor of .02. In addition, there are several elbows in the line giving it an equivalent length of 7.1 miles. Since there is no recovery cone at the point of discharge,

$$K = f\frac{L}{D} + 1$$

$$= .02\,\frac{(5280 \times 7.1)}{(3)} + 1$$

$$= 251 \text{ Eq. } 7$$

This result, of course, is based on a line size valve. The control characteristic is shown in Fig. 3 by the K=250 line. Note that 95 percent of maximum capacity is obtained at 35° open and if the line was designed for a good margin of growth, it will operate in the 0 to 15° open region during its first years of use. Note the maximum velocity obtained with wide open valve (per Equation 2) is:

$$V_{MAX} = \sqrt{\frac{2g\Delta H_e}{C_p + K}} = \sqrt{\frac{2 \times 32.2 \times 62}{.3 + 251}}$$

$$= \sqrt{15.9} = 3.98 \text{ fps}$$

and from Equation 3

$$Q_{MAX} = 352.5\ D^2V$$

$$= 352.5\ (3)^2\ 3.98 = 12{,}620 \text{ gpm}$$

By using a valve of half the line diameter, we obtain approximately four (4) times the velocity, or 16 ft./ sec. This is calculated according to Equation 2, using C_p=1.3 to account for the extra loss of relatively abrupt reducer cones and $K=250\ (18)^4/(36)^4 = 15.7$ corrected for valve size, according to Eq. 4.

Substituting this K value of 15.7 in Eq. 2, we obtain

$$V_{MAX} = \sqrt{\frac{2 \times 32.2 \times 62}{1.3 + 15.7}}$$

$$= \sqrt{235} = 15.3 \text{ fps}$$

and from Eq. 3

$$Q_{MAX} = 352.5(1.5)^2\ 15.3$$
$$= 12{,}280 \text{ gpm}$$

Then line velocity is 15.3÷4= 3.82 or 96 percent of its previous valve. It is clear to see that in problems of this type, the extra loss due to neck-down valve size has minor effect on maximum capacity. Looking at Fig. 3 for K=16, we see that the control characteristics have improved materially. The probable control range of 0 to 50 percent of maximum, allowing for a good marginal growth, will now use valve angles up to 30°. Note that the very low flow characteristics from 0 to 5 percent are now spread over a 10° range, enabling a standard valve positioner to do a good control job even at these low flows.

Establishing 16 ft./sec. as a design rule is a convenient way of limiting the effect on line capacity to reasonable values, and still adhere to the operating conditions established by AWWA to keep operating torque and cavitation effects within bounds.

In general, the best control valve is the smallest control valve consistent with required line capacity and allowable velocity through the valve.

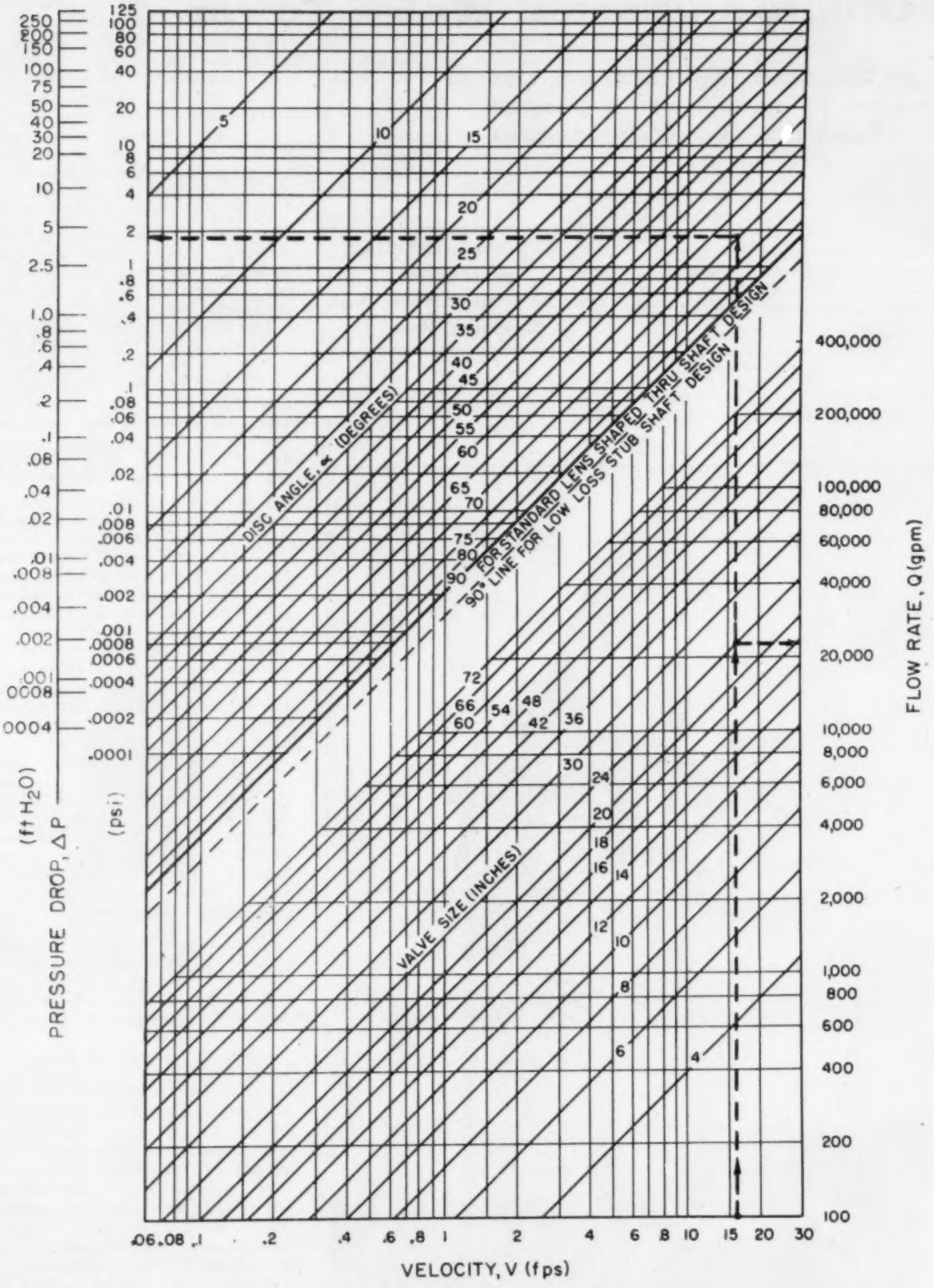


Fig. 4—BUTTERFLY valve sizing nomograph

Scituate's Unusual Water Tower

A gift from tycoon "Tom" Lawson in 1902. Designed by architect sent to Europe to study outstanding towers of historic interest.

by WILLIAM T. SHERMAN.
Superintendent
Town of Scituate Water Dept.
Greenbush, Mass.

MASSACHUSETTS' Town of Scituate boasts of having the most beautiful, the most photographed, and the most expensive Water Tower in the country. How it was obtained, at no cost to the taxpayer, makes quite an interesting story.

Ed. Note: We read of the unusual water-tower of Scituate in a news item in the press. As the result we prevailed upon Supt. Sherman to give us this interesting history of "The World's Most Expensive Water Tower".

At the turn of the century, a privately owned Water Company, then serving Scituate, had erected a wrought iron water tank (standpipe) twenty five feet in diameter and seventy five feet high.

This tank was located directly opposite the estate of Thomas W. Lawson who, in his heyday, was known as the "Copper King." To everyone from the Wall Street tycoons to the natives of Scituate he was known as "Tom." He had just spent over a million dollars on his new estate called "Dreamworld", and was not at all pleased to gaze out of his windows upon, what he considered to be an unsightly water tank.

He met with the owners of the water company and obtained permission to enclose the water tank in a structure which would be pleasing to the eye.

Not knowing exactly what he wanted, he sent an architect to Europe to sketch designs of attractive and historic towers and turrets both in England and on the Continent as far east as Constantinople.

When the architect returned with his sketches, Mr. Lawson chose one of Renaissance architecture which was a Roman tower of the fifteenth century. The contract for its construction was awarded to the Charles Logue Company of Boston.

THE UNUSUAL water-tower of Scituate, Mass. has many features of interest

Construction Features

The Tower is constructed entirely of wood and the wall and conical roof are double-shingled, for both effect and protection. Even the weather vane pole is scalloped out to give it a shingled effect.

Inside the Tower are circumferential landings at each fifteen foot elevation to facilitate the cleaning and painting of the wrought iron water tank.

The open ports of the Bell Room are not screened, therefore the entire floor is zinc covered to prevent air borne bacteria dust etc. from entering the water tank.

Rain water, carried through the open ports by high winds, run off through scuppers similar to those on a boat.

The Tower is protected by the

Lightning Prevention System of Burlington, Wisconsin. Before this system was installed, the Tower was struck by lightning but, luckily, the only damage was to the weather vane.

A tragic mishap occurred at the completion of the tower. As workmen were taking down the staging, one lost his balance and fell one hundred feet to his death. His screams, as he fell, warned other workmen directly below him and this prevented them from being carried to their death also.

The Bell and Clock Room

The Tower was built exactly to scale and its overall height of 153 feet seems to dwarf the tall spire of the adjacent church in the accompanying photograph. It was completed in 1902 and included a separate turret in which a spiral staircase ran upwards one hundred and twenty three steps to the level of a bell room.

In this bell room were mounted ten bells which were cast especially for the Tower by the Meneely Company of West Troy, N. Y.

To facilitate the playing of the chimes the bell hammers are connected with steel cables which run to the keyboard in the music room at ground level.

Also in the bell room are eleven open ports, each six feet square, which allow the sound waves from the bells to escape in all directions.

Directly above the bell room is the clock room in which a huge clock not only strikes the hour but automatically plays the Angelus on the chimes at 7:00 A.M. and 6:00 P.M.

About Costs

Completed, the Tower is said to have cost over $60,000. A recent appraisal fixed a replacement figure of $375,000, at the current price of labor and materials.

The Tower is now owned and maintained by the Scituate Water Department and is known the country over as The Lawson Tower in commemoration of the wonderful man who loved and did so much for Scituate.

Since the accompanying photograph was taken, a chain link fence, 300 feet in circumference, has been installed around the Tower and the area enclosed by the fence is covered with bituminous concrete intended to reduce the fire hazard and prevent vandalism.

Water Works Man Heads Professional Engineers

Garvin H. Dyer, director of the Missouri Water Co. and manager and chief engineer of the Independence, Mo. Division of the firm has been elected president of the National Society of Professional Engineers.

Mr. Dyer is a former chairman of both the Missouri Section of AWWA and the Missouri Water & Sewage Conference. He received the latter's Award of Merit in 1954. Mr. Dyer is also a past president of the Mid-Missouri Section of the ASCE and a past president of the Missouri Society of Professional Engineers.

Senate Votes Full Appropriation for Pollution Abatement

Action by the Senate on the appropriations bill, H. R. 6287, assures that the national water pollution control program of the Public Health Service will proceed without interruption during the coming year.

As reported by the Senate Appropriations Committee and sustained on the floor, $45,000,000—a cut of $5 million from the $50 million ten-year annual authorization contained in the Blatnik Act of 1956—was appropriated for the grants-in-aid program for the construction of municipal pollution abatement facilities.

Inasmuch as reversions to the Treasury are expected to amount to $5 million during fiscal years 1957 and 1958, the Committee instructed the Public Health Service to continue programming the grants at the original rate of $50 million per year. These amount to 30 per cent of the cost of construction of individual municipal pollution abatement plants that fit into a State-approvel plan, but not more than $250,000 to any one project regardless of size.

Although an unsuccessful attempt was made in the House to strangle the national water pollution control program by cutting off the funds, a similar effort did not develop on the Senate side. The least amount that can be agreed to in the House-Senate conference committee on H. R. 6287 will be $45 million for aid in water pollution abatement.

FOLKS: it was the best I could do with all the halls in town rented out.

Clinton Smith Returns to Birmingham as Genl. Manager

E. Clinton Smith, well known water works executive, has been named general manager of the Birmingham Water Works. He returns to Birmingham from his position as general manager of the St. Joseph, (Missouri) Water Company to succeed H. L. Shiflett who died on March 14.

Clinton Smith is not new to the Birmingham Water Works. He served as assistant general manager from 1949 to February 1, 1957. Prior thereto he had served the Compania de Acqueductos, de Cuba, in Marianao, Cuba, as superintendent and treasurer, this Cuban facility being an operation of the American Waterworks Co.

In making the announcement of Mr. Smith's appointment, Alec C. Montgomery, board chairman of the now municipally owned Birmingham Water Works said: "We are fortunate indeed to obtain the services of Mr. Smith, who has served our system so well for eight years (1949-1957) as assistant manager.

Clinton Smith is a native of New Rochelle, N. Y., and a graduate of Columbia University. He is married and has one daughter.

31st Annual Meeting

Ohio Sewage & Industrial Waste Conference

THE THIRTY-FIRST annual meeting of the Ohio Sewage and Industrial Waste Conference was held in the Miami Hotel in Dayton on June 19-20-21. There were about 160 persons registered from all parts of the state.

The officers elected for 1957-58 were: Chairman W. R. Taylor, Diamond Alkali Company, Cleveland; 1st Vice Chairman, Carl Bauer, Superintendent Water and Sewage, Celina; 2nd Vice Chairman E. W. Petrich, Howard Paper Mills, Inc., Urbana; and Secretary-Treasurer, C. E. Lay, Sanitary Engineer, Ohio Department of Health, Columbus.

Amongst the papers presented the following are briefly reviewed here.

Oily Wastes

R. I. Berman presented a film, made by the International Harvester Company, to show the Bulkley Dunton equipment used to remove the oils from waste waters used in the production of automotive equipment. The wastes originate from mineral oil injected into the steam used to operate forging hammers. Oil also comes from the degreaser washers in the heat treatment department.

There are also process washers throughout the plant that discharge alkali waters containing small amounts of soluble oil and cutting oils lost in processing. Both are treated in the waste treatment plant. The oil wastes are treated by chemical coagulation with alum and activated silica. Alum is added just ahead of the pressure tank where the air is added to the waste. Activated silica is added just before the waste enters the Colloidair unit. The floated sludge, (oil and chemical floc) is removed from the top of the unit by a flight conveyor that discharges to a pit. From here it is pumped to a tank truck that hauls it to a commercial dump. Jar tests are used to determine the chemical dosage required. The sodium silicate is activated with ammonium sulfate.

*Ed. Note: This meeting was reported by Prof. Don E. Bloodgood, Purdue Univ., Editor of "Industrial Wastes."

Presiders

F. Rusk A. D. Caster

Flotation Units

D. B. Heard, F. S. Gibbs, Inc., said that experience has shown that the handling of an oily waste prior to removal can, in a large measure, affect the success of flotation clarification. Free oils that would be relatively easy to remove by dissolved air flotation can be emulsified by improper pumping and in the emulsified state will pass through a flotation unit and into the effluent. He suggests gravity flow through a unit to eliminate pumping that may cause difficulty because of the agitation of the oil and water. It is necessary to consider each oil water separation problem separately in order to determine the most effective chemical treatment.

The Gibbs Co., has found that a thorough quick mixing of the proper chemical with the waste water, utilizing a 20 to 30 second flash mix, is definitely worthwhile. It insures an intimate contact of the chemical with the waste water, and results in a chemical savings by the thorough utilization of the chemical. In addition, they believe that in oil emulsion treatment it is desirable to provide a short period of retention for flocculation prior to flotation. In the Gibbs unit approximately 40 per cent of the design flow is pressurized with air at 50 psi, about 50 per cent of the air-aerated solution is added to the influent of the flotation unit and the other 50 per cent is distributed throughout the flotation area through a specially designed back pressure distribution system. Units with capacities of 6000 gpm are available.

Vacuum Unit

The Dorr-Oliver Vacuator was described by G. H. Koenitzer, Sales Engr. Dorr-Oliver Co. In this process the entire waste flow is aerated mechanically before it enters the Vacuator. The air requirements are between .025 and .05 cu ft per gal of waste treated with a detention time in the aeration chamber of approximately two minutes plus a short period immediately following for release of free air bubbles which might later cause surface disturbance.

The partial vacuum in the Vacuator expands the finely divided bubbles causing them, and the solid particles to which they are attached, to rise rapidly to the surface and form a thick float. The float product is continuously removed by a high capacity skimming mechanism and carried up a ramp into a trough located slightly higher than the liquid level. From the trough the float product is continuously discharged into a sump which is also under the partial vacuum. The Vacuator is designed on an overflow rate basis of 5,000 to 10,000 gal per sq ft per day. Excellent results for suspended solids and non-colloidal grease have been obtained.

Sewage Wastes

Alvin A. Friedsam, San. Engr., Process Engineers, Inc. pointed out that in sewage, the heterogeneous assortment of solids, and particle sizes present, results in the deposition on the bottom of some of the lighter solids that are not some of the fast-settling and electrically inert nature. Also, these solids are susceptible to flotation by occlusion or agglomeration with effervescing air. He claims that, as in plain sedimentation, a means for the removal of settled solids should be provided. A flotation unit should then have three separate zones, an upper where it is relatively quiescent so finely-divided air and attached solids can freely rise, a middle where flowing through occurs, yet the displacement velocities should be of such an order that there is adequate time for dissolved air to evolve and form

fine bubbles, and a bottom that is quiescent so that all particles tending to settle can do so.

Little Miami Plant

The Little Miami Sewage Works is a primary treatment plant in which it is possible to use alum flocculation as well as pre and post-chlorination. Dean Taylor, Sr. San. Engr., Cincinnati, Ohio said that both counterflow and single stage elutriation have been tried on the sludge that is filtered. The filtration rates have ranged from 0.8 to 3.0 lb per sq ft per hr with an average of 1.5 lb per sq ft per hr. At this average rate it has not always been possible to filter all of the digested sludge.

Programmers

R. D. Hoak D. M. Taylor

Tests conducted show that with the same drum speed a filter can be expected to yield about 40 per cent more cake if the sludge has 7 per cent solids than if the sludge has only 5 per cent solids. Filter cake thickness is one factor that has a great effect on filter cloth blinding. Mr. Taylor said that if cake thickness can be brought up to ¼ inch or more the cake will separate readily from the cloth. Flannel filter cloths have been found to be as economical as any covering and last, on an average of 1200 hours. In elutriation of the sludge prior to filtration the alkalinity of the sludge is reduced from 2700 to between 350 and 700 ppm., depending upon the water used in washing the sludge.

Ohio Turnpike Plants

The Ohio Turnpike sewage plants were described by George P. Manos. The turnpike is 241 miles long and there are eight sewage treatment plants located along the route. The plants are alike and they are made up of Comminutors and by-pass bar screens, control building, pumping station, "Clarigesters," primary trickling filter, secondary trickling filter, final sedimentation tank, chlorine contact tank and sludge drying beds.

The units were designed on the following basis:

1. Average sewage flow 100 gpm
2. Maximum peak day flow 175 gpm
3. Maximum peak hour flow 350 gpm
4. B.O.D. of raw sewage 500 ppm
5. Suspended solids of raw sewage equal to a population of 1500.

The plants are operated by one man who works an eight-hour day. A technical supervisor visits each plant once every eight days.

The raw sewage at six of the plants has been found to have a B.O.D. between 210 and 280 ppm while at the other two the B.O.D. is between 450 and 465 ppm. The water usages are 25,000 gal per day at the six plants and 35,000 and 50,000 gpd at the two where the high B.O.D. is found. The plants with the high flows and concentrations are midway on the Ohio Turnpike.

The treatment plants are removing 90 to 95 per cent of the suspended solids and B.O.D.

A comment from the audience was that the rest points had not been selected because of ideal conditions for the disposal of final effluent.

Toxicity of Metal Wastes to Sewage Plants

W. D. Sheets San. Engr., Burgess & Niple., has been running tests to determine the toxicity of metal finishing wastes to biological sewage treatment plants. Preliminary studies included tests to determine the effect of each metal on the B.O.D. test. In these tests a synthetic sewage was used in a series of B.O.D. bottles each containing varying amounts of the metallic salt. Using the B.O.D. of the synthetic sewage as determined without any metallic ions present, as 100 per cent, the per cent recoverable B.O.D. in all other samples was compared to it. For comparative purposes an arbitrary point of 50 per cent recoverable B.O.D. was taken as the point of declared toxicity. Some of the values obtained are given in Table 1.

TABLE 1

Concentration of Various Compounds Required to Affect B.O.D. Values 50 Per Cent

Metal	Compound	Buffered	ppm
Cr	CrO_3	Yes	4.0
Cr	CrO_3	No	0.9
Cr	$CrCl_3$	No	0.18
	H_2SiF_6	No	2.6
CN	NaCN	Yes	3.6
Zn & CN	$Zn(CN)_2$	No	0.75
Cu	$CuSO_4$	Yes	0.4
Ag	$AgNO_3$	Yes	0.3

In the experimental trickling filter studies, shock loadings were originally applied for 24 hours then changed to twelve and six hour periods. Using the 4.0 ppm as a possible toxicity point, additions of Cr and CrO_3, were applied to the pilot plant. Shock loads were used and approximately 1 ppm of Cr was added initially, increasing by 0.5 ppm at each run. The characteristic yellow color became visible at about 2.5 to 3.0 ppm. At 4.0 ppm a slight drop in plant efficiency was first noted. The appearance of the filter stone changed, apparently having lost some of the growth.

Programmers

L. F. Krapp P. Ehrenfest

The activated sludge experimental plant tests were fed approximately the the same concentrations of chromium (CrO_3) as had been used in the filter studies. About ten days passed before a trace of chromium was found in the effluent; the period was somewhat longer for the activated sludge. From the tests it has been concluded that a shock load of 10 ppm for twelve hours or less, had no detrimental effect on the activated sludge process.

Water Pollution Control

R. D. Hoak, Senior Fellow, Mellon Institute, stated that water pollution control is a topic replete with firmly held opinions that rest on insecure foundations. This arises from a widespread public and professional concern over the effects of pollution, coupled with an almost complete lack of the kind of technical information that is essential to the development of rational measures for pollution control.

To supply some of the answers needed flume studies have been made. It is apparent from the information presented that sedimentation in streams is governed by many interrelated factors. The preliminary results reported seemingly contradict some firmly held beliefs. According

to theory, particles settle most rapidly when water is quiescent. Yet, the data from the flume tests indicate that the amount of settling with laminar flow is less than it is where the flow is turbulent. Agglomeration of particles occurred and since this can result only from contact between particles, Dr. Hoak believes that turbulence increases the number of contracts, and the tendency of the particles to clump results in an increase in their settling rates. This early work has led to a long-range research project for evaluation of a number of variables that affect the behavior of suspended solids.

Pumps and Packing

One of the two section meetings held on Thursday morning was devoted to the discussion of pump bearings and packing maintenance. Three very interesting papers were presented on the subject matter.

Paul Ehrenfest, Engr. Havens & Emerson, stressed the importance of having the base plate of a pump level and properly grouted in place. He also said that the piping to and from a pump should be so well supported that none of the pipe weight rested on the pump housing, and that it should also be possible to remove the flange bolts on each side of the pump and still have the piping remain in proper alignment.

In regard to lubrication of bearings, he said, it is advisable to use the grade of grease or oil recommended by the pump manufacturer and that over-lubrication can cause about as much trouble as under-greasing.

Mr. Ehrenfest said that packing for a pump is a low cost item but if it is not used properly the results may necessitate expensive repairs. The packing can be made to last much longer and carry out its intended purpose if proper attention is given to the application of the sealing water so that it cools the shaft and packing as intended. Packing should not be compressed so tightly that there is no loss of water. A small loss of sealing water minimizes power used to overcome packing friction and the generation of heat from friction.

When a new pump is installed it is quite likely that it will be necessary to replace the packing before it is used. The packing may have dried out between the time the pump was shipped from the manufacturer and when it was installed. The packing glands should be cleaned before the new packing is installed. The packing should be of a type recommended by the pump manufacturer. The new packing should be cut in rings that exactly fit around the shaft and the joints in each ring should be staggered around the shaft.

Mr. Ehrenfest said that it was his opinion that many times when packing troubles are encountered the cause can be traced to poor shaft alignment.

Bearings & Greases

L. E. Krapp, Supt. of Maintenance, Sewage Disposal, Cincinnati, Ohio, also discussed maintenance of bearings and packing of pumps. To demonstrate the developments in lubricating greases, he told of finding in an 1856 handbook that suitable lubrication can be obtained with a grease made from 100 pounds of tallow, 70 pounds of palm oil, 28 pounds of caustic soda and 1½ gallons of water. He listed the causes for bearing failures as follows:

More Programmers

K. S. Watson — Carl Bauer

1. Dust or foreign matter in bearings
2. Improper lubrication
3. Drainage of bearing during assembly
4. Improper assembly after repair
5. Improper handling of bearings prior to assembly
6. Improper use of bearing.

Mr. Krapp said that some of the difficulties with bearings and packing can be eliminated if proper records on time of maintenance are kept along with the manufacturer's parts lists, etc.

Starting New Pump

C. L. Bandy said that he believed that the first ten minutes of operating time of a new pump will tell what the record of pump packing maintenance will be. He said that at the start of operation of a pump the packing should not be pulled up tight because the shaft will heat and cook the packing. He advocates a rather thorough greasing of the packing prior to placing when operating a pump for the first time. He suggested that the sales engineer for the particular pump be called so that he is on hand when a new pump is operated for the first time.

Discussion

An open discussion was held on the merits of using grease seals for pumps. The general impression left with the audience was that grease seals are better than no water sealing and may have to be used if it is not possible to obtain water for use in sealing.

The question arose as to the merits of mechanical seals that are now being used in some instances. There were reports of complete satisfaction with this method of sealing where the other methods had not proved satisfactory.

Fringe Area Sanitation

The session where fringe area santitation was discussed apparently created great interest as was shown by the large attendence.

D. T. Mitchell, Sanitary Engineer for Franklin County, Columbus, Ohio, said that the availability of transportation now makes it possible for workers to live twenty to thirty miles from their places of employment. An indication of the increase in suburban area living was given in the statement that in 1955 the population in the United States increased 7.9 per cent yet the suburban areas increased in population 46.9 per cent. From the standpoint of sanitation, the effect has not been good. The lots are often a half acre or more in area and consequently the cost per lot for sewers is very high, if not prohibitive. The large lots do not eliminate the necessity for adequate and safe water supply and sewage treatment, continued Mr. Mitchell. He said that the courts have held consistently that since a city cannot be compelled to serve residents outside its corporate limits, a municipality need not extend its facilities beyond that which it has voluntarily established outside the city. Suburban areas therefore cannot look to the cities to solve their suburban problems.

Mr. Mitchell said his definition of a septic tank in a built up area is: "a device whereby our obnoxious wastes are secretly moved from our own back yard to our neighbor's back yard." He advocates considering the construction of small community-type plants that are designed to provide not necessarily complete, but adequate treatment. He believes that these community plants can be constructed for about $560 per lot or $160 per capita.

Ed. Note: Other papers on industrial waste treatment are reviewed and reported on in the Sept.-Oct. issue of *Industrial Wastes*.

Technical Program

FSIWA 30th Annual Meeting

To be held at Statler Hotel, Boston, Mass., Oct. 6-10

The Federation of Sewage & Industrial Wastes Assns. has planned a full program for its 1957 meeting. As is customary, registration will begin on Sunday, and the meeting will conclude with two concurrent forum sessions on Thursday morning of that week. Inspection trips and other concurrent sessions on current topics will be featured.

The program, as released Aug. 1, is shown below; it is subject to minor adjustments in final form.

Sunday—Oct. 6

Registration

Board Meeting

Inspection of Exhibits

Monday—Oct. 7

Morning

Address of Welcome

Secretary's Report

The New England Interstate Water Pollution Control Commission .....*W. E. Wise*

Afternoon

Radioactive Waste Discharges from Nuclear Reactors .....*J. G. Terrill, Jr.*
The Effect of Syndets on Sewage Plant Operation .....*Clair N. Sawyer*
The Public Health Service Research Grants Program and Progress in Pollution Control .....*Harry A. Faber*
Treatment of Combined Domestic Sewage and Industrial Wastes .....*Leon S. Kraus*
Discussion .....*John Curry*

Evening

Family Night

Tuesday—Oct. 8

Morning

SESSION A—7:30 a.m.

Laboratory Scientists Breakfast .....*Leader, W. W. Sanderson*
Topic for Discussion, "Laboratory Methods"

Session B—9:00 a.m.

Experimental Studies and Operation Use of Synthetic Organic Coagulants for Digested Sludge Filtration at Hyperion .....*W. F. Garber, R. D. Bargman, W. F. Bargman, and J. Nagano*
Discussion .....*Erman A. Pearson*
Design and Construction Problems of the Metropolitan District Commission Sewerage System (Boston) .....*F. W. Gow and M. Cosgrove*
Recharge with Reclaimed Sewage Effluent ...*Finley B. Laverty*
Invitation to Sixth Inter-American Congress of Sanitary Engineering in San Juan, May 1958 .....*Enrique Ortega*

Annual Luncheon

Conservation of Natural Resources in New England .....*L. H. Whittemore*

Afternoon

Session A—2:00 p.m.

Research Symposium .....*Leader, Ross E. McKinney*
Techniques for Giving Chemical Identity to Organic Industrial Wastes .....*F. M. Middleton, A. A. Rosen and R. H. Burttschell*
Nitrogen Relationships in the Synthesis of Activated Sludge .....*James M. Symons and R. E. McKinney*
Bacterial Assay of Sewage and Polluted Waters by the Molecular Filter Technique .....*Jack M. McKee*
Development of Design Criteria for Waste Stabilization Ponds .....*E. R. Hermann and E. F. Gloyna*

SESSION B—2:00 p.m.

Sewage Works Panel Sessions
Evaluation of Program Grants and Construction Grants for Sewage Treatment under Federal Water Pollution Control Act, Public Law 660 .....*Leader, M. P. Adams; P. R. Bonderson, B. A. Poole, A. F. Dappert, D. B. Lee, J. C. Knox, G. E. McCallum, and F. L. Flood.*
Uniform State and Interstate Standards for the Design of Sewage Works ....*Leader, Geo. W. Martin; Earl Devendorf, J. W. Townsend and F. H. Miller*

Wednesday—Oct. 9

Morning

TOUR A—9:00 a.m.
Tour of Historic Boston and Environs (For Ladies and Men)
TOUR B—9:00 a.m.
Tour of Mass. Inst. of Tech. Pilot Plants

Afternoon

TOUR C—2:00 p.m.
Inspection Trip to Metropolitan District Comm. Nut Island Sewage Treatment Plant, Quincy, Mass.

INDUSTRIAL WASTE SESSION—2:00 p.m.

Recovery of Acid from Spent Pickle Liquor .....*C. Houck*
Phenol Recovery by Use of Isopropyl Ether *N. H. Kirchgessner*
The Water Pollution Control Program of the Pulp and Paper Industry of the Pacific Northwest .....*V. W. Bacon*
European Industrial Waste Treatment Practices ..*H. H. Black*

Evening

Annual Awards Dinner and Dance

Thursday—Oct. 10

Morning

SESSION A—9:00 a.m.

Operators' Forum (Panel Discussion of Plant Loadings) .....*Leader, W. D. Hatfield*
Grit Chambers and Primary Settling .....*F. L. Flood and L. W. VanKleeck*
Sludge Digestion .....*H. E. Schlenz and P. F. Morgan*
Activated Sludge .....*T. R. Haseltine and L. S. Kraus*
Trickling Filters .....*G. M. Fair*
Oxidation Ponds .....*H. B. Gotaas*

SESSION B—9:00 a.m.

Industrial Wastes Forum
Solving the Cooling Tower Blowdown Pollution Problem .....*Leader, L. L. Hedgepeth*

30th Annual Meeting

Central States Sewage & Industrial Waste Assn.

MEETING for the thirtieth time, the Central States Sewage & Industrial Waste Assn. held its annual meeting this year, at the Hotel Sherman in Chicago on June 26-28. The registration of 212 included about 40 ladies, and it was observed that of the remaining 170 or so, the number of sewage plant operators was in the minority.

W. E. Ross
Past Pres.

A. P. Troemper
President

R. W. Frazier
1st Vice Pres.

Federal Aid for Sewage Works

C. W. Klassen, Chief Eng. and Tech. Secy., Ill. Sanitary Water Board, Springfield, Ill. presented information on "Federal Aid for Sewage Plants—from a State's Viewpoint." Mr. Klassen believes that there are many misconceptions in the minds of many persons concerning the program of federal aid for construction of sewage treatment plants. He said that there are some persons who agree that more money is needed while there are others that think the situation would be better if there were no money at all.

In Illinois, the Public Health Service program of grants is regarded as a tool in the hands of the State to be used in accomplishing advances in the uses that tool is dependent upon the individual state's program.

To look upon this grant-in-aid program as the panacea for all financial difficulties and to regard it other than merely another means by which to carry out a state's program is to give it importance beyond that which is warranted and to admit indirectly that the federal government is the agency to furnish the principal means by which a state can carry out a program. While in the past there has been much talk of federal programs being operated primarily to assist states and local communities, it has been Mr. Klassen's experience that the present program of the Public Health Service in connection with these grants for sewage treatment plants is the first real practical demonstration of a federal agency operating to carry out the precept of aiding a state in its own activities.

In carrying out the program in Illinois, rapid development of criteria was necessary in order to take advantage of favorable bidding and construction periods and to accomplish those projects ready to award contracts. Although it was argued that projects ready for construction had the finances arranged and needed no grant, the usual computer-argument was that desirable features were deleted to bring construction costs within financial means. Therefore, without detailed analysis of the local financial effort involved, all projects were regarded as equally eligible insofar as extent of planning and state of readiness were concerned.

The construction of the act says that priorities must be based on financial as well as water pollution control need; Illinois decided to give equal weight to these two factors. It was soon found that the many factors had to be reduced to a simple scoring system.

The scoring system as given by Mr. Klassen is as follows:

Illinois Sanitary Water Board Criteria

I. Water Pollution Control	Points
1. Pollution Categories	
a. pollution exists—complaints filed	4
b. poor quality or no treatment	3
c. potential pollution	2
d. local nuisance	1
2. Degree of Pollution	
a. extremely serious	4
b. serious	3
c. moderate	2
d. light	1
3. Primary Use of Stream	
a. domestic water supply	4
b. residential, fish and wildlife, recreational, agricultural	3
c. industrial, policy, compact	2
d. other	1
4. Abatement Progress	
a. voluntary	3
b. satisfactory	2
c. poor	1
5. Prevention Progress	
a. excellent	3
b. satisfactory	2
c. poor	1

Ed. Note: This report by Don E. Bloodgood covers only the paper and discussion dealing with sewage and sewage treatment. Papers and discussion dealing with industrial wastes are reported in the Sept./Oct. issue of Scranton Publishing Co's. "Industrial Wastes"—Don E. Bloodgood, Editor

II. Financial Need (Midpoint figures used from the following table)

Assessed Valuation $/Cap.	Points	Construction Cost $/Cap.
500	9	180
1000	8	160
1500	7	140
2000	6	120
2500	5	100
3000	4	80
3500	3	60
4000	2	40
4500	1	20

Illinois received 59 applications for assistance and these were scored according to the system outlined above. The first 18 received serious consideration and 1/3 of those who started construction could not have done so without the help of the federal program.

Aerobic Biological Purification

M. B. Ettinger, San. Eng. Center, USPHS, Cincinnati, Ohio, gave a paper on the fundamentals of aerobic biological purification. In a biological system it is assumed that it contains a very small "seed" or a large mass of organisms such as the sludge in an activated sludge plant. A liquid substrate containing the food must also be present. The food may be dissolved, suspended or in colloidal suspension. In the system described by Mr. Ettinger, some of the food is designated as common food. This is material that can be readily used by the organisms that are present. Some of the food may be designated as exotic because it is used with difficulty by the organisms that are present. The decomposition of the exotic foods may take place after a long lag period during which there is very little use made of it by the organisms.

Federation Directors

W. W. Mathews O. J. Muegge

Mr. Ettinger believes that immediately after the food and the organisms come in contact there may be rapid adsorption of some of the food involved. The total material absorbed is likely to be small in most cases and part of the exotic absorbed chemicals may be released later. After the food the amount of biological material present will increase to a maximum as the result of growth and multiplication and once this maximum of biological material is formed further respiration will result in progressive decrease and destruction of solids.

After the bacteriological growth reaches its maximum, further aeration results in destruction of biological solids. Upon further aeration the amount of solids present will equal those initially present and continued aeration now causes the amount of biological solids to decrease below the initial level. It is believed by Mr. Ettinger that as the system ages there is an increase in the amount of oxygen used.

Prof. G. W. Lawton, Asst. Prof. of San. Eng., Univ. of Wis., Madison Wis. and C. Eggert, Lt., USAF, reported on research that showed the "Effect of High Sodium Chloride Concentration Wastes on Trickling Filter Slimes." An example is saline whey from an experimental cheese development. He concluded that the stabilization of highly saline wastes by biological treatment is feasible providing sharp changes in the sodium chloride concentration do not occur. Slime growths develop readily even with high salt concentrations in the waste, providing the B.O.D. loading is not excessive. Filter growths that are developed from low salt content wastes suffer a shock effect when high salt content wastes are applied to them, but they are said to become acclimated to the high salt diet in a relatively short period. Similarly, filter growths accustomed to high salt content wastes show a shock effect when weekly saline wastes are applied but they usually become acclimated to the new substrate in about one day. Professor Lawton's tests also revealed that wastes with B.O.D. concentrations of 1500 ppm do not readily develop normal filter growths either in the presence or absence of sodium chloride.

Business

Paul Brunner of Fort Wayne was elected third vice-president of CSSIWA. W. W. Mathews and O. J. Muegge were elected as the new Directors to the Federation. The new secretary elected was Scott E. Linsley of St. Paul, Minnesota. The 1958 annual meeting is scheduled to be held at Purdue University at the same time as the Purdue Industrial Waste Conference.

In addition to these papers, an Operation Breakfast was held, with the topic for a panel discussion being "Sewage Treatment Plant Operating Problems." Among those participating in the panel were: Ray Anderson, of Waukegan, John Sager of Minneapolis, Carl Wahlstron of La Cross, Wis. and Chas. Niles, Cons. Engr. of Indianapolis.

Programmers

C. W. Klassen R. Anderson

The program also included four papers on industrial waste treatment. A report on these papers appears in the Sept.-Oct. issue of *Industrial Wastes*.

"Ed" Goehring Passes

Edwin C. Goehring, in the words of the Beaver Falls, Pa. press, "well-known and popular manager of the Beaver Falls Municipal Authority and active community leader" died at his home in Beaver Falls on July 13, 1957 after an extended illness. He was 56 years old.

"Ed" Goehring was a native of Holyoke, Mass. He went to Beaver Falls 32 years ago as Chemist and Assistant Manager when the water utility was a privately owned property. In years past he had been very active in the Penna. Water Works Operators Assn. and in the Penna. Section of AWWA.

As a civic leader he was a member and past-president of the Beaver Falls Kiwanis Club and an enthusiastic leader in its achievements. He was president of the Highland Suburban School Board and vice-president and chairman of the finance committee of the Chippewa School Board.

"Ed" is survived by his widow, a daughter and son living in Beaver Falls.

DURING early lagoon operation evaporation equaled inflow and filling was slow

Waterville, Wash. Has

Economical Lagoon System of Sewage Disposal

by PAT THOMSON
County Engineer
Douglas County
Waterville, Wash.

MODERN SEWAGE DISPOSAL does not have to have dirty, odoriferous conditions. Yet, clean odorless disposal does not necessarily have to be accomplished through the conventional type of filtration treatment. In fact, it has been proven that an unconventional type can serve the small town as efficiently as standard units, and at a smaller cost, both initially and maintenance-wise.

The small town of Waterville, Wash., population 1,000, was faced with a difficult problem. The eastern portion of the town had been sewered sometime in the past under individual local improvement district projects. The western portion of the town, rightfully, also desired the advantage of sewage facilities. However, the Washington State Health Department would not approve the additional facilities without better, more efficient, appropriate methods of disposal.

To ascertain the extent of the problem before the council, Helmer-Hughes, Wenatchee consulting engineers, were engaged to make a survey of the present system, the needed system, and the necessary disposal unit.

This revealed the existing facilities to consist of 16,385 linear feet of 6-inch and 1,315 linear feet of 8-inch collection sewers, 6,185 feet of 8-inch main sewers, and 5,000 feet of 8-inch outfall sewer. Treatment consisted of septic tanks of various capacities and construction, located at the ends of the branch sewers. Effluent from these septic tanks discharged to main sewers and then to the outfall sewer with an outlet to Corbaley Creek.

Recommended Program

No regular program of cleaning and maintaining had been possible in the past. Hence, the effluent from the various septic tanks varied widely, being very turbid, with a bad odor, and a high percentage of solids. The recommendation called for the construction of a local improvement district in the western portion of town, a new outfall line, trunk lines, and a disposal unit.

It soon became apparent that such problems are not settled with equanimity. It was more than 18 months from the initial reconnaissance until final settlement of the type and extent of the new system. In the interim, the council arguments were long and heavy. The public also had definite pros and cons. However, in the final hearing the majority of the property holders voted for the system and the method of financing. Those solid blocks strictly against new facilities were cut from the system. Public-relation-wise, every effort was made to satisfy the greatest number of people. There are, of

course, always some who feel they are adversely affected, regardless of effort to the contrary.

From the standpoint of cost, a disposal type new to the Pacific Northwest was considered. This is the process known as lagooning. Correspondence and photographs showed that this process had been highly successful in the Central and Midwestern States. It is attractive as a final disposal method because the cost is considerably less than that of other conventional infiltration methods.

What is the process? Lagooning consists of constructing a disposal pond to 3 to 5 feet in depth by diking. These dikes are constructed from the material excavated from within the lagoon area, serving to deepen the lake as dikes are made. The very nature of the process limits the city size for which it can be profitably used, as an acre of lagoon is required for each 100 persons. It also is desirable to have additional acreage for predicted future growth.

The process requires three main points: plenty of sunshine, consistent breezes, and a wide open area of clay or other water-retaining soil.

Lagoon operation is simplicity itself. Raw sewage enters the water-filled lagoon approximately at the center, slightly above subgrade elevation. The lagoon is placed strategically in relationship to the prevailing winds. Thus, wind action and the resultant wave action cause the raw sewage to move over the lagoon area, preventing a piling septic condition. A lagoon pond of 3- to 5-foot depth represents optimum conditions for wind and wave action, yet it is deep enough to prevent total-depth freezing in most climates.

As the raw sewage spreads thinly over the lagoon bottom, digestion begins almost immediately. The broken particles of sewage are attacked by both aerobic and anaerobic bacteria. Algae growth in the water causes a supersaturated oxygen condition. This tends to give a fast consumption of organic sewage carbon compounds. Sewage digestion and purification is good, reported reaching from 65 percent in the dormant winter months to 98 percent in the summer months.

Project Initiation

With the decision by the council to proceed, the first problem became the acquisition of right-of-way. The first obstacle was the psychological hurdle of what every townsman termed an adjacent "sewage pond". Actual use has proven this objection invalid. However, the final lagoon was located about a mile from town.

D-7 TRACTOR pulling carryall loaders in muggy muck trench during lagoon construction.

Actual right-of-way purchase hinged on two items. The same psychological approach was used—that odor would not be a problem. Also, this is a highly agricultural economy. Wheat-producing land is valuable land. Price had to be determined, but 13 acres of land with access rights were finally purchased for $200 per acre.

Method of Financing

It was now time to establish financing. Two separate bond issues were used. The local improvement portion is assessed directly against the property especially benefitting from the lateral sewer improvement. The owner may pay this by:

1. Paying cash within 30 days of final notice without interest.
2. In ten equal installments of principal with 5 percent interest.
3. In installments and interest for a number of years, then paying the balance and interest at the next anniversary.

This local improvement district (LID) assessment is a lien against the property second only to general taxes. The city must establish a guarantee fund from a levy out of the 15 mils, guaranteeing the payment of interest should collections be insufficient. Legality requires that LID bonds be sold at not less than 100 par. If such is not done, the contractor is required to take them in his payment. In that case, his bid will cover any discount he must suffer in peddling them. Original assessment costs were determined as $1.89 per front lot foot with a $100 minimum hookup charge per unit.

Sewage revenue bonds pay for the portion benefitting the entire community and not one specific area. These bonds will be repaid, principal and interest, from the sewer revenues and no other source. The revenues obtained from the monthly sewer charge made against each residence and business structure will first be used to defray the expense of operating and maintaining the sewer system, and then to pay the principal and interest of the sewage revenue bond issue.

The sewage revenue bonds will be repaid in annual installments over a 20-year period, with the right of the town to pay them off faster than

OUTLET BOX, with space for chlorination unit if effluent control tests show necessity.

LATERAL lines were placed quickly and efficiently, with the least possible disruption to traffic. Pipe laying is right on heels of digging crew.

the stated maturity on and after five years from the date of issuance.

The town agrees to charge rates for sewer service that will produce sufficient revenues to operate the system, and then provide not less than 1.4 times the principal and interest requirements that year on the sewer revenue bonds. The surplus thereby created may be used to expand the system, or applied against the bond issue on or after the option date. This procedure could well retire all of the revenue bonds by 1970, several years ahead of the stated maturity date. Monthly use charge was determined at $2 per month per residential unit, and $4 per month per business unit.

Bids were called April 11, 1956, with Goodfellow Brothers, Inc., Wenatchee, Wash., the low bidders with an amount of $84,510.94. This was awarded, with work commencing on May 1. The project was completed August 23, for an amount of $98,-171.45. This was an over-run of $13,-660.51, caused by $3,279.72 in extra work orders, 10,000 cubic yards of extra lagoon excavation, and 1,332 cubic yards of rock trench excavation. The final estimate was paid on September 1. Of the total contract, $22,518.57 was the LID system, giving a final front footage charge of $114 per linear foot, or $0.75 less than anticipated.

Lagoon Area Problems

The lagoon was in a natural basin known as Corbaley's Pond. Although the area was surface dry, once the crust was broken it didn't take long to determine why there was such a rank growth of marsh grass. Just about the time the first "cat" went out of sight in the lagoon area, construction commenced on the outfall line with a solid rock cut.

To complicate matters more, an unheard-of stratune of water showed up in the rock trench. Have you tried laying sewer pipe lately in a trench where a spring bubbles faster than two pumps can handle the inflow? It is somewhat discouraging when you can't lay a manhole faster than the rising waters.

It was also necessary that the contractor exercise care on the 6,000 feet of outfall line. Most of this was through wheat land, damaged crop had to be paid for, and no indiscriminate shifting of equipment could be allowed. Land had to be left in a suitable condition for harvest and future farming activities. Only the minimum of leveling was permitted for trencher travel.

Lagoon dike construction was of organic-free material placed in 6-inch layers compacted by sheepsfoot rollers. Utilization of the lagoon began in June at the commencement of one of the region's driest seasons. It had originally been hoped to hit the season when rain, snow, and extra pumping could help fill the lagoon. During the months of July and August seepage, sun, and wind evaporation about equaled the inflow. Therefore, a portion of the lagoon had to be diked transversly to allow one portion to fill more rapidly. Still, even on the hottest day of the year, under the most adverse operating conditions, the lagoon gave off no detectable disagreeable odors.

During design, both the State Health Department and the Pollution Control Commission expressed the desire to have influent and effluent flow measuring devices in the outfall line and lagoon discharge. Original plans included a Cipolletti wier in both locations. However, the pollution Control Commission required that the influent wier be changed to a Parshall flume. Thus, an Armco metal 6-inch throat Parshall flume was installed in a concrete structure just above the lagoon entrance of the outfall line, including gage wells and recording meter pits. Meters are to be provided by the state if deemed necessary.

Chlorination was not put in, for until the effluent can be tested for a period, there is no way of knowing how much or to what degree this added treatment must be provided. Space is provided, however, for a contact chamber and a hypochlorinator as being best adapted to the requirements.

Problems on Laterals

The lateral town lines also presented their problems. Maps of the existing water and sewer installations were non-existent. Missing lines were located by the simple expedient of merrily trenching away until spurting water jets announced the discovery of another line. Everyone would then stare, saying: "I'll be d . . . .! Who'da thunk it was over there?" But in spite of these troubles, there was an excellent job of pipe laying—fast, neat, and efficient.

Topography was such that one area had to be served with a lift station. This was of the standard manhole type, containing two Fairbanks-Morse vertical motor, sleeve bearing, non-clog, wet pit sewage pumps. Each pump is capable of delivering 50 gpm against a total dynamic head of 30 feet at a maximum allowable 1,800 rpm. All openings are large enough to permit passage of a 1.5-inch sphere. Pumps are automatic through the operation of a switch float set for predetermined liquid level. Two gravity lines lead into the pumping station back through a central pressure pipe.

In connecting with the old sewer lines, some interesting things developed. One old line, about 350 feet in length, had been constructed of tin irrigation pipe. When it was opened to be tapped, there was nothing, for the pipe had long since rotted away. The only reason the opening remained so was the constant flow of liquid. This replacement involved additional line, creating grade problems because it was desired to shorten the distance as much as possible.

In another instance, the old line was on almost a level grade. It took a painted marker 1 1/2 hour to travel 300 feet. With the additional facilities introduced through the new line, if two were flushed simultaneously, someone had to "man the decks" for a calamity. So another extra work order went into effect.

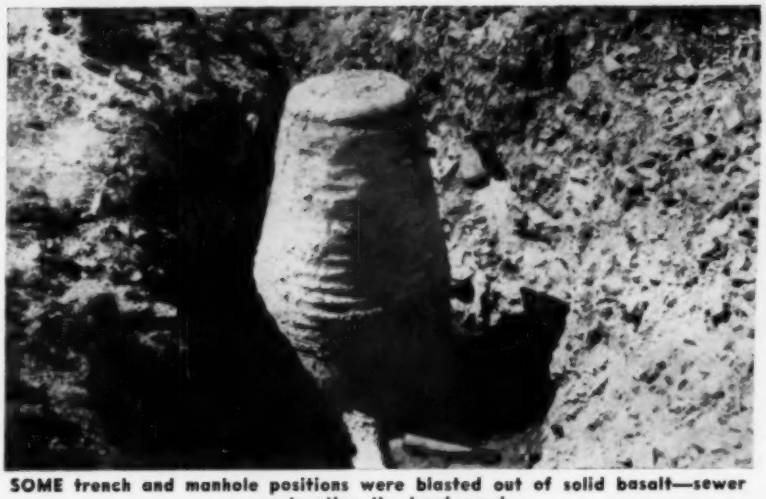
Probably the most disappointing aspect, from the contractor's viewpoint, was the cement clay structure encountered in excavating for the lateral lines. If the contractor blasted,

there was the considerable expense of suitably backfilling the resultant wide ditch, then redigging for pipe laying. If the contractor didn't shoot, the cement clay beat men and equipment to bits at unclassified excavation yardage rates. This one factor alone probably caused the most grief.

Ingenious Solution to Forming Problem

One problem was solved uniquely. The flat slab of the pressure pump pit had to be fitted with a standard circular manhole cover. This presented a forming problem for a circular form that was smaller than the opening and easily removable. This was solved by using the wooden ends from telephone lines reels, somewhat smaller in diameter than a manhole cover. Four of these, each 2 1/2 inches thick, were spiked together, giving proper depth. These were then wrapped with rope until the desired diameter was obtained. The whole was then covered with a light tin, nailed through the rope with lath nails, leaving one rope end free. Once the concrete was set, the free rope end allowed unraveling of the rope and removal of the wooden disks. Presto! A perfect circular opening in any flat slab.

In evaluating the construction of any public utility, the prime consideration is best service for least cost. For Waterville, the lagoon system was some $60,000 cheaper than the conventional tank system would have been. When this was written, the lagoon had been functioning properly and efficiently. Thus, the prime duty has been fulfilled.



SOME trench and manhole positions were blasted out of solid basalt—sewer construction the hard way!

The system has been in operation for 16 months. It has successfuly weathered one of the worst winter conditions this area has seen since 1916, with temperatures ranging to −10°F and a total snowfall of 121 inches. During August, three roaring cloudbursts caused extensive road and field damage. None of these weather conditions hindered the efficient operation of the lagoon.

Flocks of ducks and geese have used the lagoon as a feeding resting place on both fall and spring migrations. Small bird life is abundant. The only animal problem has come from several families of muskrats moving into one end of the lagoon intent upon establishing permanent housekeeping. Although trapped and removed to other waters, they insisted on returning, establishing burrows in the dikes. Otherwise, the biggest maintenance factor has been mowing the weeds on the dikes, which have not yet been seeded to grass. One section of woven wire fence that a deer thoughtlessly ploughed into had to be rebuilt.

The Waterville lagoon has provided a useful, economical, cheaply maintained sewage treatment system, operating without fuss or muss. Since this community pioneered lagoon installation in the Northwest, four others have been constructed in the immediate vicinity and more are being planned.

Another Golden Anniversary for a Water Works Man

"Nick" Hoeltzner celebrates 50th year of service with Rock Island water works

N. J. "Nick" Hoeltzner on Sept. 1, 1907 came to work as steam-engineer in the pumping station of the Rock Island, Ill. Water Department. Five years later he was made Chief Engineer in the water department. Through hard work and self-development he earned the promotion to Assistant Superintendent of the department in 1934 and in 1935 was elevated to the post of superintendent, which position he held for 22 of his 50 years with the Rock Island Water Department.

On September 1st "Nick" Hoeltzner celebrated his 50th anniversary of continuous service to one water department. In recognition of this "Golden Anniversary of Continuous Loyal Service to the City of Rock Island, Ill." a special luncheon was tendered "Nick" Hoeltzner on Sept. 4th by city officials and friends. On Sept. 7th he was further honored at a testimonial dinner given by water works employees and friends.

The Rock Island Water Works dates back to August 1871, when untreated Mississippi River water was steam-pumped into the mains. Twenty years later (1891) one of the very early Jewel Filter Systems was installed 66 years ago. Later (1897) filters of the slow sand type and presettling basins were added. Still later (1909) the system was further amplified by the installation of early rapid gravity-type mechanical filters and chemical treatment.

It must have been a "tough pill" for an old steam pump man to swallow when "Nick" Hoeltzner in 1935 changed over his steam pumping station to an electrified station, with consequent marked reduction in pumping costs.

Hats off! to "Nick" Hoeltzner one of the very few "Golden Anniversary Water Works Men" who have served one community for a half century.

Ed Eldridge Joins USPHS

Edward F. Eldridge, who has been director and chief engineer for the Washington Pollution Control Commission, in Olympia, Wash. since

1948 has resigned that position to become associated with the Pacific Northwest Office of the United States Public Health Service. In his new position Mr. Eldridge will be a Special Research Assistant in the Water Supply and Water Pollution Programs of the USPHS.

REPORT FROM ABROAD

The Industrial Effluent Problem in Britain

Cooperative discussions are expected to help solve the major problems arising from inclusion of industrial wastes in sewage treatment plants of local authorities

by JOHN FINCH

Mr. Finch is Manager of the Sewage Disposal Department, Slough, England. In his reports from abroad he discusses topics and opinions of timely interest. He welcomes the opportunity of replying personally to readers desiring additional information regarding subjects covered.

THE FIRST of what is hoped will be a regular series of organized meetings between the Institute of Sewage Purification, local authorities, and industry—in fact, what is hoped will become a feature of the Institute of Sewage Purification's way of life, as it were—was held recently at Birmingham, England, under the chairmanship of that past-master of the office, Dr. Arthur Key, Senior Chemical Inspector for the Ministry of Housing and Local Government.

The meeting, which took place in the University of Birmingham, was officially opened by Alderman A. Paddon Smith, Chairman of the Birmingham Tame & Rea District Drainage Board. It took the form of a symposium on trade wastes and was organized by the Midland Branch of the Institute. Representatives from the local authorities in 15 counties, together with representatives from industry, government departments, river boards, research associations, and consulting engineers were among those attending.

Importance of Industrial Wastes

The reason for this meeting is not far to seek.

During 1956, the incidence of industrial effluents on sewage treatment and sewage treatment plants in Britain assumed an increasing importance due to the development taking place in industry. In the latter part of that year, this industrial development gained increasing momentum, as also did the interest in the treatment and disposal of industrial effluents, and caused considerable thought to be given to a problem which is now creating sizeable headaches for many local authorities.

The problem is now of such dimensions that few if any local authorities responsible for sewage treatment have no industrial effluent problem; many are simply overwhelmed by a problem which becomes more acute with the passing of years, and now extends into areas which at one time had no such troubles.

Without any possible doubt, the really most significant factor in this change, and one which must of necessity create an increasingly difficult problem for the local authority as industrial development proceeds, is that whereas a few years ago many sewage treatment plants treated a large amount of domestic sewage plus a much smaller amount of industrial effluent, some of these same plants are now having to deal with an industrial loading which is bigger than the domestic sewage load.

The Central Advisory Committee on River Pollution, in its Second Report, recommended that industrial effluents should be discharged into the public sewers for treatment at the sewage treatment plant, where it is practicable to do this. And, of course, the river authorities are agreed that this is the best way of dealing with the industrial effluent problem, for although the centralized treatment of these wastes is generally more economical (a point of interest to the industrialist, who often disputes this fact) the total amount of polluting matter reaching the river is, of course, reduced.

A study of the various reports of the River Boards indicates quite clearly the effects of industrial effluents on the rivers and streams, and although much is being done by industry to cut down pollution, much still remains to be done before the problem is solved—if ever it is solved. At the Symposium, a number of aspects of the industrial effluent problem were covered in the shape of technical contributions entitled:

"Problems Concerned with the Acceptance of Trade Wastes into Public Sewers," by M. A. Kershaw.

"Obligations of Local Authorities and Traders under the Rivers Pollution Prevention Acts," by M. Lovett.

"Treatment of Some Industrial Or-

ganic Wastes," by D. H. Sharp.

"Acid Wastes and Their Neutralization," by S. H. Jenkins and C. H. Hewitt.

"Treatment of Plating Wastes and Cyanides," by A. E. J. Pettet.

"Gas Works Effluents and Their Effect on Sewage Treatment," by W. T. Lockett.

Pretreatment

Mr. Kershaw's paper dealt with the pretreatment of industrial wastes at the factory and the inspection and control of the effluents included in the public sewer for treatment at the sewage treatment plant. He described a system which he has operated with a very considerable degree of success catering to a wide range of industrial effluents. The system has stood the test of time and its success is largely due to simplicity, increased cooperation between industry and the local authority, and the comparatively few occasions on which there has been a major upset due to the effects of a strong trade effluent.

He said that pretreatment at the factory should be provided to protect sewer fabric; reduce to a minimum the possibility of sewer blockages; obviate, so far as possible, any damaging reaction between two or more trade effluents discharging into the same sewer; and prevent, as far as possible, interference with the purification processes at the sewage treatment plant. From the financial angle, the charges for the treatment of trade effluents at the sewage treatment plant should always be tied up with the actual cost of sewage treatment at the plant concerned.

In discussing the paper, Councillor L. Chaffey, of the Birmingham Tame & Rea District Drainage Board, said that as a result of increasing quantities of gas liquor from coal carbonization and trade waste the Birmingham Tame & Rea District Drainage Board was faced with installing works at a capital cost of something like £8-£10 million. He also made the comment, which is a very pertinent one to local authorities, that it was not fair to saddle the cost of this plant on the ratepayer, but that it should be shared out among industry concerned.

Mr. Lovett, who is Chief Inspector of the Yorkshire Ouse River Board, and worthy successor to J. H. Garner, knows something of pollution and pollution problems, for he is concerned with one of the most heavily industrialized areas in the world, the South Yorkshire industrial belt.

He stated that it is obviously desirable that close contact should always be maintained with the river board, and in particular that there should be the earliest possible consultation with the board regarding new projects or extensions of existing processes. He said that many river board officers have a wide experience of sewage and trade effluent treatment processes and may be able to offer assistance and advice on such problems.

Effluent Standards

In the introduction to his paper, Mr. Lovett stated that higher effluent standards were required to safeguard lowland streams, in view of the fact that about one-quarter of the population of Britain is supplied with drinking water taken from lowland streams that are liable to pollution in some degree by sewage or industrial effluent. He continued to comment that much of the ever-increasing demand for domestic and industrial water supplies could only be met by further extraction from lowland streams, and that more and more use would have to be made of such streams.

D. H. Sharp, of Fisons Pest Control Ltd., in his paper described effluent treatment processes employed at a latex, a rayon, a textile dyeing and finishing, a pharmaceuticals, and a pesticides factory. In each instance some form of pretreatment is necessary before the effluents are given biological treatment. The methods of pretreatment covered in the paper include sedimentation, coagulation, chemical treatment, and adsorption on activated charcoal.

Dr. Sharp concluded that it would seem that some form of pretreatment is required before biological treatment can be given to organic wastes, and that this treatment may need to be (a) physical only, such as sedimentation and coagulation; or (b) chemiical treatment. and adsorption and dosage to assist decomposition or precipitation of contaminants; or (c) a combination of both physical and chemical treatment.

During the discussion one speaker made the point that there was some doubt in many minds as to whether river board standards were the standards to work by, and that the time was eagerly awaited when chemical tests and observations could reasonably predict the effect of an effluent on the life of a river. He then mentioned the investigations being undertaken by the Water Pollution Research Group, the Ministry of Agriculture and Fisheries, and the Fresh Water Biological Association into the effects of effluents on fish life.

A very interesting section of Dr. Sharp's paper was concerned with the treatment of effluent from cellulose acetate rayon at the works of British Celanese, Ltd., at Derby. Pilot plant experiments have shown that this effluent, after pretreatment comprising neutralization and sedimentation, can be satisfactorily treated biologically in admixture with sewage.

Initial experiments with activated sludge lasting nearly a year had to be abandoned because although the final effluent from this plant was very good indeed, the suspended solids could not be easily separated from the effluent by settlement. The sludge in fact "bulked," due to the excessive growth of *Sphaerotilus natans*. In consequence of this inability to make use of the activated sludge process, the effluent from the rayon plant will be treated at the Derby sewage treatment plant in admixture with sewage, by the alternaing double filtration process.

Acid Wastes

Probably the most interesting paper in the symposium was the one presented by Dr. Jenkins and Mr. Hewitt of the Birmingham Tame & Rea District Drainage Board on acid wastes.

In their paper the authors say that the vast increase in the use of acids and the general increase in industrial activity during recent years have combined to make the treatment of sewage more difficult, and that this and the higher standard expected from sewage treatment plants make it essential that industry should do more to pretreat many discharges which had previously been accepted into public sewers.

To neglect this would mean that sewage treatment plants already unable to treat the sewage properly would begin to fail utterly, because it must be realized that purification processes depend on living organisms and that many industrial effluents are harmful to these forms of life. Such discharges cause sewage to leave the treatment plant unpurified, and on passing into rivers render them lifeless. Acid discharges alone can have this effect; it is intensified when they also contain salts of the heavy metals.

Various types of discharges are discussed in the paper, including those containing iron, copper, and chromium, as well as waste acid which is free from metallic salts. It is stated that acid iron pickling liquor is probably the biggest single discharge in the Birmingham district, but dipping

acid containing zinc and copper is included in considerable volumes. Instances are given showing the composition of some of these wastes and their effect on the composition of sewage at the point of discharge and when it reaches the sewage treatment plant.

As an example of the damage caused by acid wastes, the authors noted that the surface of a filter at the Yardley sewage treatment plant of the Board had ponded on account of acid pickle liquor discharged to the sewer. The acid waste had reduced biological activity to such a degree that the establishment of the purifying organisms had been prevented and fungal growths had accummulated to a point where the proper drainage of the filter was impeded.

In addition, iron dissolved in trade wastes had become deposited on the filters in the form of hydroxides. Trade waste discharges into the Yardley sewage treatment plant had cut the production of gas by nearly one half, although the amount of sludge had been increased by nearly 50 percent and the digestion temperature raised from between 70° and 80° to between 90° ond 95°.

Metal Finishing Wastes

A. E. J. Pettet, of the Water Pollution Research Laboratory, considers that the most satisfactory method of disposing of waste waters from metal finishing is by discharge to the public sewers, but pretreatment is nearly always necessary to avoid harmful effects in the sewer system and at the sewage disposal plant. He considers that before a treatment plant is designed and installed at a plating establishment, it is advisable to consider whether any practicable steps can be taken to reduce the volume of waste waters produced and to reduce the amount of processing chemicals discharged in the waste waters. Acid wastes containing metal salts, but not cyanide or chromate, can be satisfactorily treated by controlled neutralization and sedimentation in a continuous flow plant. Waste washing waters containing chromic acid or chromates are usually treated by reduction with either ferrous sulfate or sulfur dioxide, followed by precipitation of the reduced chromium by the addition of an alkali.

During the course of the discussion on Mr. Pettet's paper it was learned that an apparatus had been invented and installed which automatically titrated and destroyed cyanides in plating effluents with potassium permanganate according to the amount of cyanide present. In addition air agitation had reduced the amount of potassium permanganate by more than 50 percent.

William T. Lockett, lately chief chemist at Mogden, discussed in his paper the course, character, and composition of gasworks effluents from carbonization plants and of high polluting value. He also dealt with new developments of considerable interest, including the steam-cracking of heavy petroleum residues produced in the course of catalytic cracking of oil for motor fuel. After experiments with this effluent on the activated sludge process using well-oxidized sludge capable of bringing about nitrification, it was concluded that the effluent in admixture with sewage exercised no appreciable retarding action on the purification process.

Langdon Pearse Memorialized

Mrs. Langdon Pearse receives plaque at the Langdon Pearse Memorial Dinner of the Central States Sewage Works Association

At the close of the 30th Annual Meeting of the Central States Sewage and Industrial Wastes Association the Association fittingly memorialized the late Langdon Pearse, former chief Sanitary Engineer of the Metropolitan Sanitary District of Chicago, at the Langdon Pearse Memorial Dinner in Chicago on June 27th, 1957.

The accompanying photograph shows Mrs. Pearse holding the memorial plaque. On her right stands "Sam" Greeley a former partner of Langdon Pearse's and on her left stands Mr. Pearse's former boss, Horace P. Ramey, Chief Engineer of the Sanitary District of Greater Chicago.

The inscription on the plaque reads as follows:

> "The Central States Sewage and Industrial Wastes Association at its 30th Annual Meeting recognizes with deep gratitude his service to the Sanitary Engineering Profession in honoring
>
> LANGDON PEARSE
> 1877—1956
>
> As a founder and respected adviser of this Association and the Federation of Sewage and Industrial Wastes Associations; a researcher and developer of modern sewage treatment methods; Chief of the Sanitary Division of the Metropolitan Sanitary District of Greater Chicago and engaged in the development of its world famous works; an internationally known Sanitary Engineer active in many national and international professional societies, he was untiring in his efforts in advancing the humanitarian cause of public health in community life."
>
> Presented to Mrs. Langdon Pearse this twenty-seventh day of June, Nineteen Hundred and Fifty-seven at Chicago, Illinois.

Mrs. Pearse and Friends

"Tom" Skinker Retires as St. Louis Water Commissioner

Thomas J. Skinker, Water Commissioner for the City of St. Louis, Mo., retired early this year having held the post since 1941. Mr. Skinker had been with the Department of Public Utilities since 1913.

As Water Commissioner, Mr. Skinker was in direct charge of all phases of the city's water supply. A long time active member of the AWWA he has received a deservedly great amount of credit for the high standing of the St. Louis Water Works.

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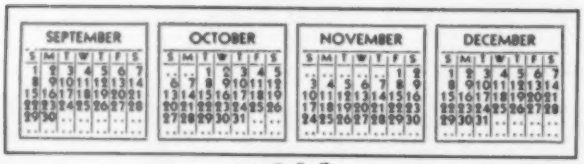

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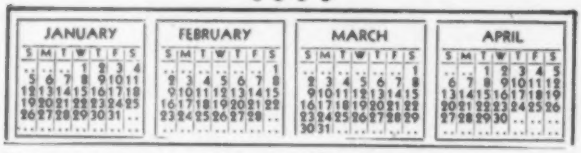

Sept. 4-6—Milwaukee, Wis. (*Hotel Schroeder*)
WISCONSIN SECTION, A.W.W.A., Secy., Harry Breimeister, Chief Utility Engr., City Engineer's Office, City Hall, Milwaukee 2, Wis.

Sept. 11-13—Upper Saranac Lake, N. Y. (*Saranac Inn*)
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, Rensselaer Valve Co., c/o Ludlow Valve Co., 11 W. 42nd St., New York, N. Y.

Sept. 11-13—Sioux Falls, S. D. (*Sheraton-Cataract Hotel*)
23RD ANNUAL SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Secy., Charles E. Carl, S. D. Water & Sewage Works Conference, Pierre, S. D.

Sept. 15-18—Boston, Mass. (*Hotel Statler 75th Anniv'y. Conv.*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 15-18—Baltimore, Md. (*Lord Baltimore Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Secy., F. J. Van Antwerpen, 25 West 45th Street, New York 36, N. Y.

Sept. 16-18—Pullman, Wash. (*State College of Washington*)
FIFTH BIENNIAL INLAND EMPIRE WATER WORKS SCHOOL, Prof. G. H. Dunstan, State College of Washington, Pullman, Wash.

Sept. 18-20—Cincinnati, Ohio (*Netherland Plaza Hotel*)
OHIO SECTION, A.W.W.A. Secy., M. E. Druley, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio

Sept. 23-25—Louisville, Ky. (*Brown Hotel*)
KENTUCKY-TENNESSEE SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell, Cons. Engrs., 553 S. Limestone Street, Lexington, Ky.

(*Jointly With*)

KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., S. Leary Jones, Cordell Hull Bldg., Nashville, Tenn.

Sept. 24-25—Santa Fe, N. M. (*La Fonda Hotel*)
ROCKY MOUNTAIN SECTION, A.W.W.A., Secy., Jack W. Davis, Dist. Mgr., Transite Pipe, Johns Manville Sales Corp., 301 Continental Oil Bldg., Denver 2, Colo.

Sept. 25-26—Stillwater, Okla. (*Oklahoma A & M College*)
OKLAHOMA INDUSTRIAL WASTES CONFERENCE, Prof. Quintin B. Graves, Oklahoma A & M College, Stillwater, Okla.

Sept. 25-27—Detroit, Mich. (*Leland Hotel*)
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Chief, Sec. of Water Supply, State Dept. of Health, Lansing 4, Mich.

(*Continued on page* 116*A*)

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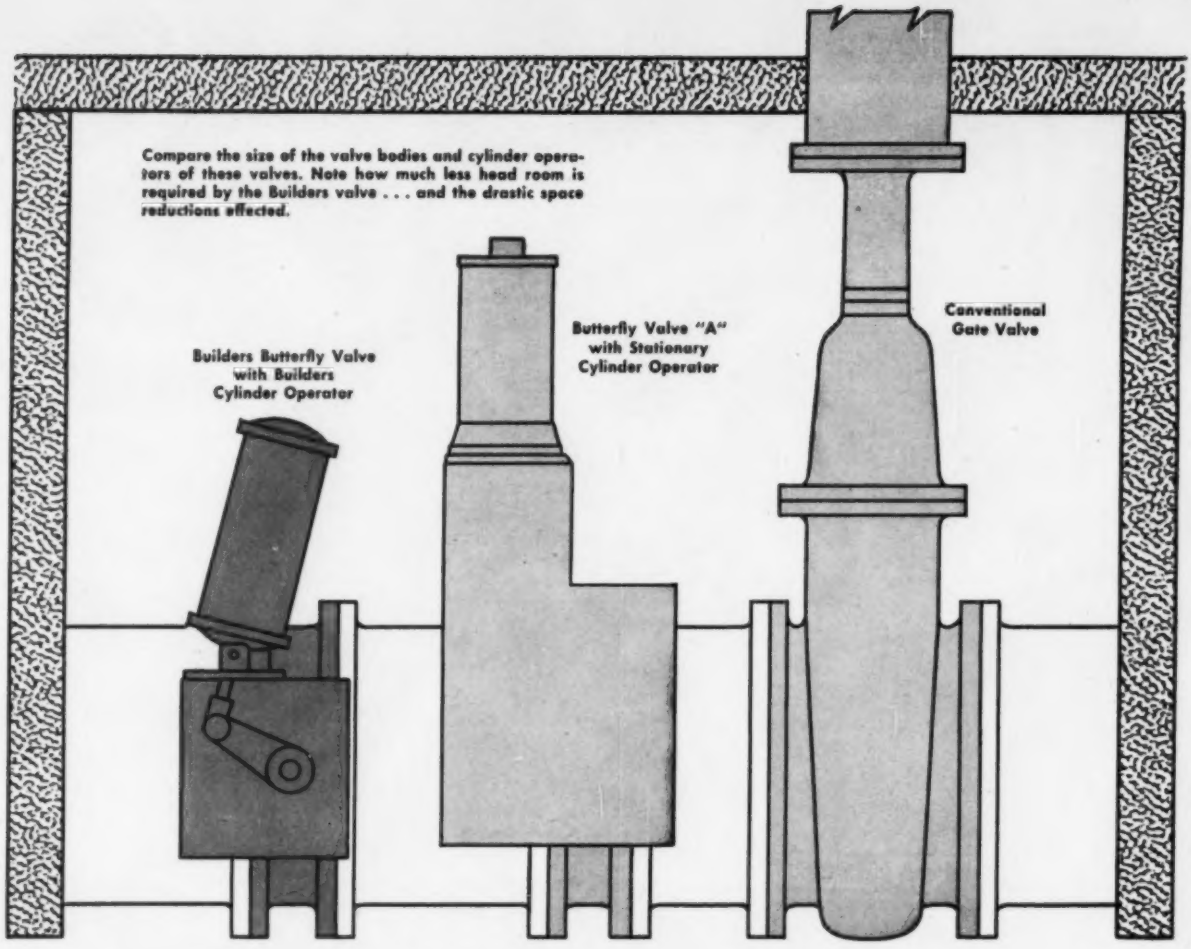
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Sept. 25-27—Fargo, N. D. (*Gardner Hotel*)
NORTH CENTRAL SECTION, A.W.W.A., Secy., Leonard N. Thompson, General Manager, Water Dept., St. Paul 2, Minn.
(*Jointly With*)
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Secy., Jerome H. Svore, c/o State Dept. of Health, Bismarck, N. D.

Sept. 29-Oct. 1—St. Louis, Mo. (*Hotel Sheraton Jefferson*)
MISSOURI SECTION, A.W.W.A. AND MISSOURI WATER & SEWAGE CONFERENCE, Joint Meeting, Secy., Warren Kramer c/o State Office Bldg., 6th Floor, Jefferson City, Mo.

Oct. 7-10—Boston, Mass. (*Hotel Statler*)
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSNS., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N. W., Washington 16, D. C.

Oct. 8-11—Atlantic City, N. J. (*Chalfonte Hotel*)
PENNSYLVANIA WATER WORKS ASSN., Secy., David Dunlap, 2609 N. Second Street, Harrisburg, Pa.

Oct. 10—South Paris, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Oct. 13—16—Oklahoma City, Okla. (*Municipal Auditorium*)
SOUTHWEST SECTION, A.W.W.A., Secy., Leslie A. Jackson, Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 14-18—New York, N. Y. (*Hotel Statler*)
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wiseley, 33 W. 39th Street, New York 18, N. Y.

Oct. 16-18—Des Moines, Iowa (*Fort Des Moines Hotel*)
IOWA SECTION, A.W.W.A., Secy. J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Iowa

Oct. 17-18—Halifax, Nova Scotia (*Nova Scotian Hotel*)
CANADIAN SECTION, A.W.W.A., 10th Annual Meeting—Maritime Branch, Secy. J. D. Kline, Pub. Service Comm., P. O. Box 608, Halifax, N. S.

Oct. 20-23—Biloxi, Miss. (*Buena Vista Hotel*)
ALABAMA-MISSISSIPPI SECTION, A.W.W.A., Secy., C. M. Mathews, Asst. Supt., Public Service Comm., 19 West Commercial Street, Yazoo City, Miss.

Oct. 21-23—Pittsburgh, Pa. (*Hotel Penn Sheraton*)
18TH ANNUAL WATER CONFERENCE, Secy., W. M. Porter, Engineers' Society of Western Pennsylvania, Hotel Penn Sheraton, Pittsburgh 30, Pa.

Oct. 23-24—Wheeling, W. Va. (*McLure Hotel*)
WEST VIRGINIA SECTION, A.W.W.A., Secy., Hugh W. Hetzer, Engr., West Va. Water Service Co., P. O. Box 1906, Charleston 27, W. Va.
(*Jointly With*)
WEST VIRGINIA SEWAGE & INDUSTRIAL ASSN., Secy., G. O. Fortney, c/o State Dept. of Health, Charleston 5, W. Va.

Oct. 24-26—Atlantic City, N. J. (*Hotel Madison*)
NEW JERSEY SECTION, A.W.W.A., Secy., Albert F. Pleibel, 683 Prospect Street, Maplewood, N. J.

Oct. 24-26—Seattle, Wash. (*Franklin Hotel*)
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Gilbert H. Dunstan, State College of Washington, P. O. Box 176, Pullman, Wash.

Oct. 28-30—Toronto, Ontario (*King Edward Hotel*)
CANADIAN INSTITUTE ON SEWAGE & SANITATION, Secy., Dr. A. E. Berry, Administrative Office, 72 Grenville St., Toronto, Ontario, Canada

Oct. 29—Nov. 1—San Jose, Calif. (*Civic Auditorium*)
CALIFORNIA SECTION, A.W.W.A., Secy., Henry J. Ongerth, Bureau of San. Engr., 905 Contra Ave., Berkeley 7, Calif.

Oct. 30-Nov.1—Washington, D. C. (*Sheraton-Park Hotel*)
CHESAPEAKE SECTION, AW.W.A., Secy., Carl J. Lauter, 6955—33rd St., N.W., Washington 15, D. C.

Full Automatic

ENGINE CONTROL

for Diesel, Gasoline or Gas

Dependable Synchro-Start controls provide full AUTOMATIC STARTING AND STOPPING according to the operation of any type of pilot switch. FULL PROTECTION is provided all the time the engine is starting or running. In case of an abnormal condition, such as low oil pressure, overheating, overspeeding, failure to start, etc., the engine will be shut down before any damage can occur and a VISUAL SIGNAL and an AUDIBLE ALARM will show the exact cause of failure.

Write today for the Synchro-Start catalog, or see your engine dealer.

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PHOTOVOLT
pH Meter MOD. 115

A full-fledged line-operated pH Meter of remarkable accuracy at the unprecedented price of **$130.-**
(complete incl. electrodes)

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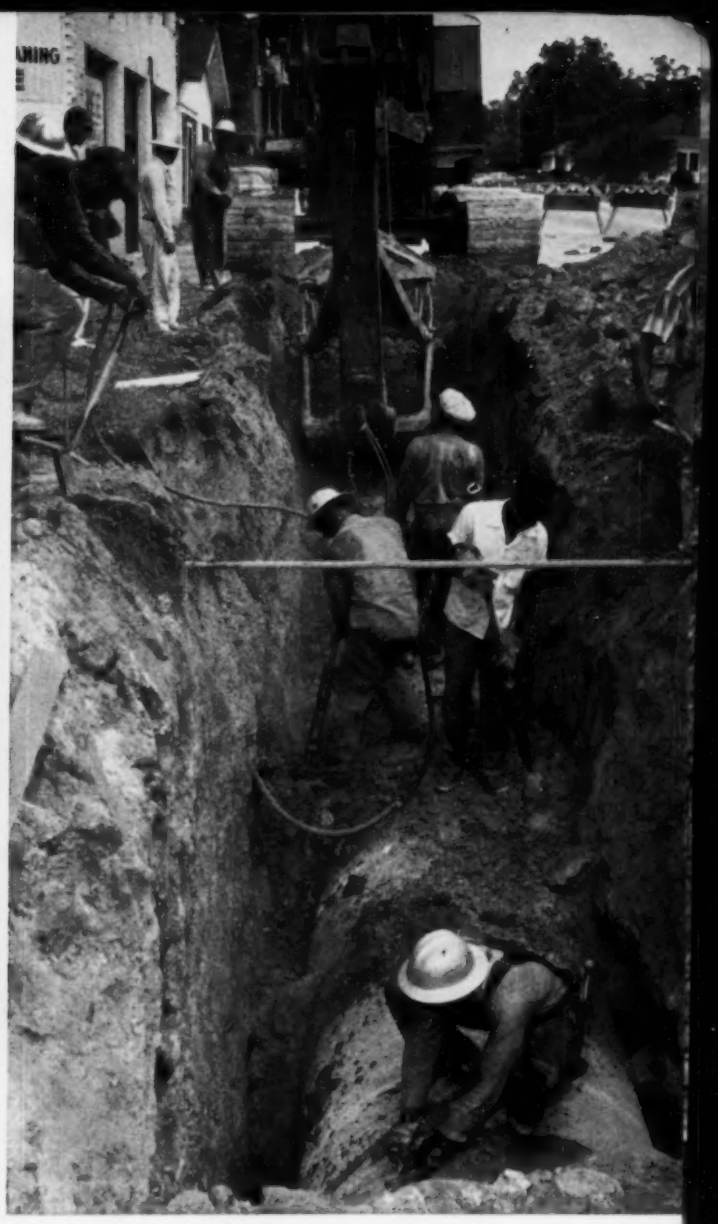

Traffic Flows At Mobile, As Concrete Water Line Goes In Fast

If you will look at these pictures, taken in Mobile, Alabama, you will see why this water line went in with little interference to traffic and adjoining business establishments.

In the left picture the backhoe has just opened a short section of trench, picked up a 16-foot length of pipe, and lowered it into position.

In the right picture, the backhoe opens next section as workman at bottom mortars the joint and others tamp backfill. High lift will finish backfill immediately.

The prestressed concrete steel-cylinder pipe used on this 9-mile line for the city of Mobile, has the strength to resist heavy traffic loads, deep backfills, and the shifting of unstable soil. Steel joint rings imbedded in concrete make joints the strongest point in the line. Recessed rubber gaskets assure a bottle-tight, flexible joint.

The 48" pipe in the pictures was designed for 150 pounds operating pressure.

J. B. Converse & Company, Inc. of Mobile were the engineers for this project which included 24, 30, 48 and 60 inch pipe. Charles F. Smith & Son were the contractors, and the pipe was manufactured by Price Brothers Company at Hattiesburg, Miss.

Price Brothers

W & SW

Spillway

OVERFLOW FROM THE MAIN SECTION

Earl Norman is Dead

Was first chairman of AWWA's Michigan Section

Earl E. Norman, long-time Director of Water and Light Utilities at Kalamazoo, Mich., died in February. We have but recently learned of his passing. He had been in poor health for some time and resigned as manager of Kalamazoo utilities after 35 years service with the Department.

Mr. Norman contributed a good deal to the advancement of the water works profession in Michigan and was honored by being chosen the first chairman of the new Michigan Section of AWWA in 1938. Later 1951-1953 he served as Director of the Section. He became a member of AWWA in 1924 and a Life Member in 1954. The Michigan Section voted to Earl Norman the Fuller Award in the same year, 1954.

This writer recalls that Mr. Norman was a consistent attendee of AWWA conventions, contributing to open discussion in a helpful manner. He was responsible for many innovations in water works practice and was a pioneer in the successful application of cathodic protection to steel tanks.

HTH

complete chlorination from source to faucet

Use HTH Granular for quick, direct, chlorine action at every point of the water-supply system: reservoirs, pumping stations, filters, mains . . . to say nothing of tanks, standpipes, wells, ponds, etc.

Dry, non-dusty, and easy-to-use . . . convenient, effective and economical . . . HTH Granular, with 70% available chlorine, means an end to problems of bacteria, algae, fungi and odors.

Olin Mathieson will gladly send you complete information about the many uses of HTH for the complete chlorination of water. Just write. Or check your supply house soon.

HTH GRANULAR is available in 100-lb. drums and in cases of nine 5-lb. cans.

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INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.
HTH® is a trademark

Ill. Tech. Offering Graduate Course for Sanitary Engineer

A graduate program in sanitary engineering—stressing the fundamental sciences—will be offered this fall at Illinois Institute of Technology, Chicago.

The program will produce an engineer-scientist who can perform well in any branch of sanitary engineering, according to Elmer I. Fiesenheiser, director of Illinois Tech's civil engineering department.

Four foundation courses make up the program:

(1)—Sanitary science, covering principles of inorganic chemistry, organic chemistry, biochemistry, nuclear physics, and biological decomposition.

(2)—Sanitary engineering analyses, emphasizing derivation and analysis of data for use in rational design.

(3)—Unit operations and processes in sanitary engineering, covering the rational design of the operations and processes used in sanitary engineering.

(4)—Design of sanitary engineering treatment processes, dealing with the application of unit operations and processes to the design of the over-all treatment processes.

Admission is open to students with engineering bachelor's degrees. Both day and evening courses will be offered.

For further information, contact the Graduate Office, Illinois Institute of Technology, Technology Center, Chicago 16.

Workmen ready 60" O.D. wrought iron intake lines for rugged cross-country service

Corrosion resistant Wrought Iron water lines need no protective coatings and wrappings

Wrought iron's unique built-in protection against corrosion eliminates the need for costly coatings and wrappings on underground water lines.

This built-in protection stems from a defensive network of over 250,000 glasslike iron silicate fibers present in each cross-sectional square inch of wrought iron. When corrosion attacks, these fibers quickly arrest any pitting or rapid penetration.

Wrought iron's relative immunity to corrosive soils and waters has been proved in actual service. Our booklet, *Wrought Iron for Underground Services*, gives case history support for the low annual cost of this material. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Pittsburgh, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N. Y.

Available in Canada and throughout the world

BYERS Wrought Iron Tubular and Hot Rolled Products

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

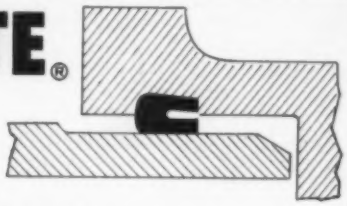
Corrosion costs you more than Wrought Iron

Buffalo Meter's Chas. Bassett Director of BDSA Water & Sewage Division

The Buffalo Meter Co. of Buffalo N. Y. has loaned Charles K. Bassett, Vice President and Secretary of the company to the Business and Defense Services Administration of U. S. Department of Commerce for the last half of 1957. He will serve as Director of the Water and Sewerage Industry and Utilities Division. Mr. Bassett becomes another in the line of WOC men who have served in this capacity to represent the water and sewage works industry. He succeeds Richard V. Ford of the Ford Meter Box Co.

This division like others of the Defense Service Administration is maintained on a standby basis to be quickly available in the event of another national emergency. Meanwhile, information concerning the abilities and needs of manufacturers of water and sewage work equipment is being kept up to date.

FLUID-TITE® JOINT

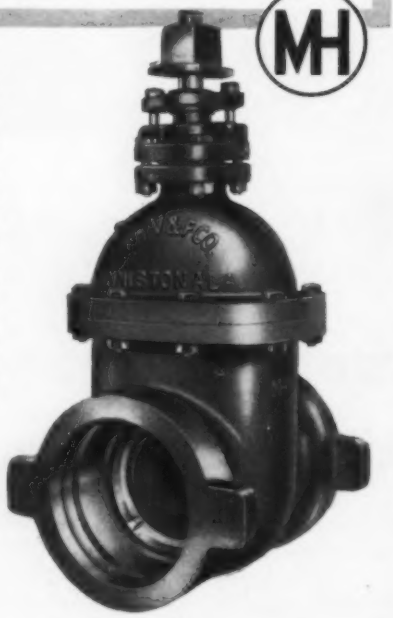


VALVES & HYDRANTS FOR "CENTURY" ASBESTOS-CEMENT PIPE LINES

Specify FLUID-TITE* end-connections on M&H valves or hydrants ordered for installation with Class 150 "Century" asbestos-cement pipe. The hub ends of this valve or hydrant are especially designed to accommodate the FLUID-TITE gasket, and seal the joint when the end of a "Century" asbestos-cement pipe is inserted (see cross-section sketch of joint above).

No special fittings or extra joint materials are required. The only joint accessory is the gasket. Installation is simple and easy. Unskilled workmen can assemble the joint.

Either conventional or "O"-Ring stuffing box is available on M&H FLUID-TITE joint non-rising-stem gate valves. Wire or write for complete information.



*Registered trademark for Keasbey & Mattison Co.®

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

Annual Reports Received

Among the annual reports received recently are the following:

CRANSTON, R. I. (Sewage Works)—Annual Report of sewage treatment plant for fiscal year ending Sept. 30, 1956. This 36-page bulletin, issued by the Commissioner of Public Works and Supt. Water C. Anderson, covers a description of the plant, summary of operations, flow diagram of the plant, data on suspended solids, BOD removals, as well as river data. Also included are studies on an experimental model of activated sludge unit employing the "Cavitator", problems of aeration tank foaming, general maintenance, cost of operation, detailed operation of sewage treatment plants, facilities, equipment repairs, etc.

* * *

MIAMA, FLA. (Sewage Works)—A 20-page booklet titled "Safeguard Guarding Miami's Health and Cleanliness of Our Waterways". It contains a map of the entire project and a story of Miami's sewage disposal project which was eight years in the preparation and three years in construction. It began operation on September 17, 1956. The booklet includes project costs, information on intercepting sewers and flow mains, a large photograph of the area, pictures and data on the operation of sewage pumping stations and the construction of the sewage treatment plant itself. This is not strictly an annual report since the operation has only been under way approximately a half year, but undoubtedly this is the forerunner of annual reports to come.

* * *

NEW YORK CITY (Public Works Dept.)—This 128-page report, prepared under the direction of Frederick H. Zurmuhlen, Comm. The book is a complete report on the various divisions of the Dept. of Public Works, including the Div. of Buildings, Bridges, Sewage Disposal, Building Management, Administration, Contract Procedure, Engineering Services, Shops, Motor Vehicles and Emergency Div. of Civil Defense. Also included are reference data on engineering, operating and personnel, as well as charts, tables and maps. This is a complete story of the Dept. of Public Works of the City of New York for the year 1956.

USCOWELD PLASTIC PIPE FITTINGS

Greater Joint Strength—Faster Insertion—Thanks to

THE ONLY SOLVENT-WELD FITTING WITH AN INTERFERENCE FIT!

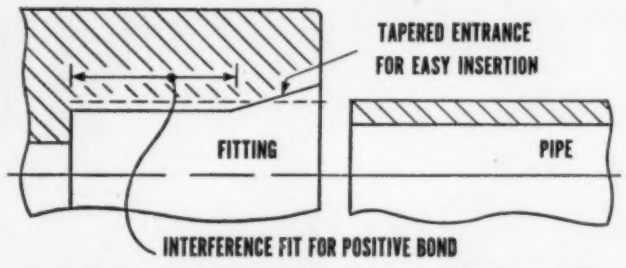
To get maximum joint strength, interference fit is a must! UscoWeld fittings are designed to provide at least a .005 inch *interference fit*. And UscoWeld fittings are a cinch to install because of a specially designed *tapered entrance socket*. U. S. Rubber has developed the unique UscoWeld fitting of the same tough, lightweight, corrosion-resistant thermoplastic as famous Uscolite® CP plastic pipe.

All UscoWeld fittings can safely handle the pressures recommended for the corresponding size of extra-heavy Uscolite pipe. Maximum recommended operating temperature is 170°F. Pipe can be cut to exact length, is easily installed in close quarters.

Obtainable at any of our 28 District Sales Offices, at selected distributors, or write us at Rockefeller Center, New York 20, N. Y.

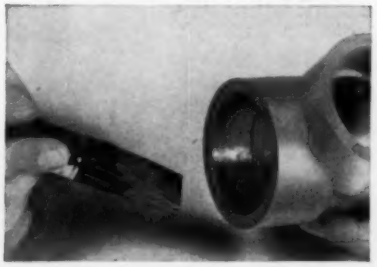
In Canada, Dominion Rubber Co., Ltd.

THE USCOWELD PRINCIPLE



By combining tapered entrance socket and a .005 inch interference fit—even when the pipe is at the small limit of the diameter tolerance and the fitting at the large limit of its diameter tolerance—UscoWeld is easily installed, and the strongest solvent-weld joint available.

Apply Uscolite CP cement to the outside area of the pipe that is to be in contact with the socket.



Next apply cement uniformly to entire inside area of *tapered entrance* socket.

While both cemented surfaces are still wet, insert pipe in fitting and push until pipe bottoms against shoulder in the fitting.

ADVANTAGES

- fast, easy to assemble—tapered entrance provides easy insertion of pipe
- strong joint—interference fit provides for optimum fusion of pipe and fitting into homogeneous mass; joint strength not dependent on cement alone
- automatic alignment of pipe and fittings
- chemical resistance of the UscoWeld joint is the same as for Uscolite pipe
- UscoWeld takes maximum advantage of the inherent "solvent-weldability" of plastic pipe and fittings
- no threading required—just cut pipe square
- not necessary to allow for thread make-up variation—pipe can be cut to exact lengths
- easy to install in close quarters
- resists fatigue due to vibration or thermal stresses by elimination of stress concentration at thread roots.

Mechanical Goods Division

United States Rubber

W&SW

New Equipment

Adjustable Stroke Diaphragm Pump

901

Denver Equipment Co., Denver, Colorado, has announced production of a new 4 inch adjustable stroke diaphragm pump which makes possible a longer stroke and up to 75% higher capacity. Adjustments can be made while pump is operating.

Space requirements have been reduced for easier installation and maintenance—unit is only 50 inches high. Lower horsepower is required because anti-friction bearing design practically eliminates friction and reduces maintenance. Standard ball-bearing motor is used to drive speed reducer. The improved design increases life of the molded rubber, nylon cord diaphragm. Diaphragm is clamped in place so there are no holes to concentrate stress or weaken it. The molded rim evenly distributes tension to the entire circumference. Diaphragm assembly can be removed from front or rear of pump by removing only 4 bolts.

"Out of sight—out of mind" can be a mighty expensive philosophy in any water distribution system. The above unretouched photograph proves this point. It shows a badly tuberculated *eight inch* main whose *inside diameter was reduced to an average of almost 4.5 inches.* Resultant higher pumping costs with reduced pressure and carrying capacity make it costly to tolerate such conditions. That is why the savings effected in reduced pumping costs frequently pay for the *low cost* of National water main cleaning.

Since there's never a charge or obligation to inspect your mains, *call National now!*

Call in National today!

NATIONAL WATER MAIN CLEANING COMPANY

50 Church Street • New York, N. Y.

ATLANTA 3, GA., 333 Candler Building • BERKELEY, CALIF., 920 Grayson Street • BOSTON 15, MASS., 115 Peterboro Street • CHARLOTTE, N. C., 533 Hollis Road • CHICAGO, ILL., 8 So. Dearborn Street • DECATUR, GA., P. O. Box 395 • EL MONTE, CALIF., 2024 Merced Avenue • FLANDEAU, S. D., 315 N. Crescent Street • KANSAS CITY, MO., 3707 Madison Avenue • MINNEAPOLIS, MINN., 200 Lumber Exchange Building • RICHMOND 21, VA., 2910 W. Clay Street • SALT LAKE CITY, UTAH, 502 West 3rd Street • SIGNAL MOUNTAIN, TENN., 204 Slayton Street • VILLA PARK, ILL., 424 S. Yale Avenue • MONTREAL, CANADA, 7445 Chester Avenue • WINNIPEG, MANITOBA, 576 Wall Street • BOGOTA, COLOMBIA, Apartado de Correos 25 • SAN JUAN 10, PUERTO RICO, Manquinaria, Apartado 2184 • LIMA, PERU, Bolivar 441-A, Marafi • CARACAS, VENEZUELA, Apartado 561 • OSLO, NORWAY, Radhusgaten 30

Gas Detector

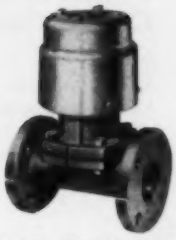
902

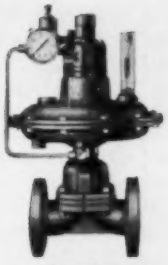
Johnson-Williams, Inc., Palo Alto, Calif., has developed a new portable gas detector for measuring natural gas concentrations from 0 to 100%. Termed the Gas-Pointer, this detector is designed for pin-pointing leaks in buried pipelines, and also for testing manholes and valve boxes, and as a general-purpose combustible gas indicator.

Two ranges are built into the instrument. Indications on the low range are obtained by catalytic oxidation on a platinum filament, and on the high range indications depend upon thermal conductivity from a non-catalytic filament.

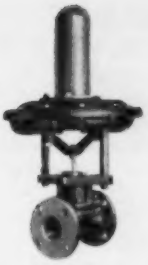
The design permits range change without any electrical switching or zero change, and without addition of dilution air. It is light in weight (5 lbs.), small in size and is fabricated from die-cast aluminum and fiberglass for rugged service requirements.

Barber-Coleman


Bendix-Westinghouse Rotochamber


Conoflow

Fisher Governor


Foxboro Reversible Stabiflo

General Controls Hydramotor

GRINNELL-SAUNDERS DIAPHRAGM VALVES with famous name POWER OPERATORS

Grinnell Air Motor, Spring Loaded

Grinnell Air Motor, Double-Acting

Grinnell Piston

Hammel-Dahl Close-Coupled

Hammel-Dahl Preloaded

Kieley & Mueller

Mason-Neilan

Minneapolis-Honeywell

Philadelphia Gear Limitorque

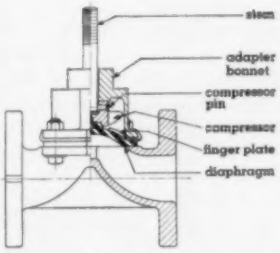
Taylor Motosteel

GRINNELL-SAUNDERS Diaphragm Valves are easily equipped for power operation — by combining any of numerous power operators, a sliding stem bonnet assembly, and a valve body. The sliding stem bonnet can be modified to accommodate any make of power operator, pneumatic or electric.

Grinnell-Saunders Diaphragm Valves are unsurpassed for handling materials as diversified as corrosive fluids, gases, beverages, foods . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors.

The operating principal of the Grinnell-Saunders Diaphragm Valve is simple. The resilient, flexible diaphragm is lifted high when the compressor is raised and pressed tight against the body weir when the compressor is lowered.

Grinnell valves are available with body, lining, and diaphragm materials to meet different service conditions. Write for further information.



This sliding stem bonnet is specially designed for power operation. The power operator is attached to the adapter bonnet and to the threaded end of its free-sliding stem. Thus, the operating force is applied *directly*. The stem, in turn, is directly connected to the compressor which opens and closes the valve when power is applied. This sliding stem bonnet is interchangeable with other bonnet designs.

GRINNELL
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Diaphragm Shields

903

The Garlock Packing Co., Palmyra, N. Y., has available seven sizes of standard molded Teflon and Kel-F diaphragm shields to fit diaphragm valves in the three inch and under size range.

These shields are installed over a rubber diaphragm to provide corrosion and heat resistance, and are unaffected by all chemicals normally found in industry. They are attacked only by molten alkali metals, chlorine trifluoride, and fluorine at elevated temperatures and pressures. They are not affected by alkalis in any concentration nor will they swell or change weight when boiled in solvents or acids.

Diaphragm shields are tested for pin holes by exposing the diaphragm surface to 30,000 volts. Shields have also withstood cycle testing using water at 90 psi, surpassing 100,000 cycles, after which the diaphragm still withstood the 30,000 volt spark test.

Centrifugal Pumps

904

Aurora Pump Div., New York Air Brake Co., Aurora, Ill., has developed a new line of close-coupled end suction Type B general purpose pumps in horizontal, close-coupled horizontal, pedestal mounted, flange mounted vertical, and base mounted vertical units.

Designed to meet critical suction conditions, these pumps possess low NPSH characteristics. Motors are NEMA standard—drip-proof, splash-proof, totally enclosed, explosion-proof and chemical as required. Overload protection is built-in on fractional HP, single phase motors. Impellers are of advanced design for peak performance, exactly balanced for smooth, quiet operation. Mechanical seals or packing glands are available. Bronze fitted, all iron, all bronze and other alloys as required.

New "Instant" Antifoams

905

The Hodag Chemical Corp., Chicago, has announced an entirely new concept in antifoam agents—"instant" anifoams. "Instant" antifoams come in flake or powder form. They are simply added to water and immediately emulsify.

Hodag's "instant" antifoams in concentrated form save the user from paying for water or other diluent which is frequently a major portion of conventional antifoam solutions. For instance, a 25 lb. bag of Hodag "instant" antifoam could make the equivalent of ten 55-gallon drums of conventional liquid antifoam. This provides substantial savings for the user in both the purchase price and the freight charges. Considerably less storage space is required also.

Hodag's "instant" HC-300 antifoams are packaged in the exact weight and quantity that the user needs for making his emulsion. This service saves user's time, effort, money and antifoam.

Reinforced Abrasive Cutter Wheel

906

Beaver Pipe Tools, Inc., Warren, Ohio, has announced a new fiberglass reinforced abrasive cutter wheel for specific use on Beaver No. 14 and No. 20 Speed-Cut Abrasive Cutoff machines.

The new Beaver fiberglass wheel is designed for cutting ferrous material. It is break-resistant, and has greater resistance to side pressure. The wheel comes in 14 and 20 inch diameter with 1 inch arbor.

R. D. Wood, Leader Since 1

A Low-Cost Hydrant You Can Depend On

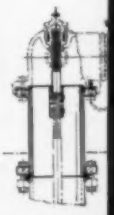
The R. D. Wood Standard Swivel Joint Hydrant gives you the most for your money in strength, reliability and sound design. The *all-bronze stuffing box*, gland and operating nut prevent rust and corrosion. Internal friction which might lower pressure is reduced to well below A.W.W.A. specifications by tapered nozzleways and carefully rounded changes in diameter.

Breakable Flange and Stem Coupling

Available at slight extra cost. Designed to snap under a blow which would otherwise smash the hydrant, flange and stem coupling can be inexpensively and quickly replaced without excavation.

Extension Piece

Can be inserted without interrupting water flow.



Hydrants now available with O-Ring Seal when specified

Evans To Manufacture Plastic Pipe

907

The Evans Pipe Co., Uhrichsville, Ohio, has announced its entry into the production of polyethylene plastic pipe, to be manufactured at its recently purchased Carrollton, Ohio plant.

The plastic pipe division of the Evans Pipe Co., designated as the Evanite Plastic Co., will manufacture a complete line of plastic pipe in two types, and in diameters from ½ to 6 inches.

Evanite Pipe will be available in two types—#1 for potable water and food products use, and #2 for water, waste and chemical service. Evanite #1 is manufactured from material approved by the National Sanitation Foundation.

Both types are made of tough, lightweight polyethylene plastic, specially compounded to produce a pipe that resists slit-holing and stress-corrosion cracking. Both will be manufactured in Schedule 40 standard wall and in 75-pound working pressure types.

ce 1803, Presents

A Gate Valve Built for Generations of Trouble-Free Operation

The R. D. Wood Gate Valve can be depended on to work and keep on working for years. It is simply constructed—a spreader and two discs are the only moving parts. The discs are free to revolve their full circumference, preventing uneven wear on faces and seats. When fully open, gates are entirely clear of flow.

R. D. Wood Gate Valves now available with O-Ring Seal when specified

all available with mechanical joint and flange-type pipe connections

R. D. WOOD CO.

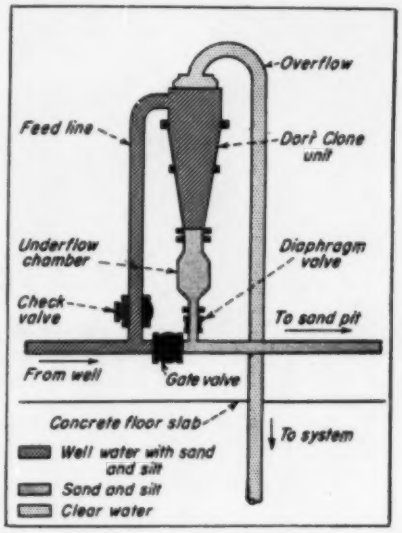
Public Ledger Building, Independence Square • Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Desanding System For Well Water

908

Dorr-Oliver Incorporated, Stamford, Conn., has developed the new DorrClone desanding system for water supplies.



The system consists of a vortex separator and an underflow chamber. Well water enters the upper section of the separator and maintains a vortex action. The centrifugal force throws sand and silt in the raw water to the outside walls of the cone, where they pass downward into the underflow chamber. Desanded water moves to the inner spiral of the vortex and out into the supply system.

The separator unit is basically a classifier that will make a separation of particles somewhere between 500 and 200 mesh. A test installation at Hobbs, N. M., using a 24 in. desanding unit, removed 673 lb of sand per day from 1.26 mgd average flow.

Light Steam Cleaner

909

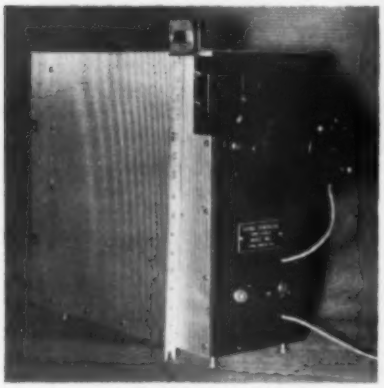
Clayton Manufacturing Co., El Monte, Calif., has developed a compact new steam cleaner called the Clayton-Kerrick 60 "Handyman" steam cleaner. It has a 60 gallon capacity and is handy for light duty general utility cleaning.

The cleaner is a complete self-contained unit. Operating on water pressure, it requires no auxiliary pump. Like the "120" Clayton cleaner it carries a 10-year service guarantee, assuring the purchaser protection for 10 years against excessive and recurring service charges.

New Ozonator For Odor Control,
Also Checks Condensation
910

Invex Inc., Coral Gables, Florida, has developed the Invex Ozonator for use in water purification, sewage odor control, and industrial wastes treatment.

The particular ionization chamber used in the Invex Ozonator is a by-product of a nuclear research project, and is said to provide high ozone output at low current consumption. The Ozonators are currently provided in standard package units of 140 and 300 cu. ft. min. at a concentration of 20 ppm ozone.



The company also places emphasis on a by-product, the effective reduction of condensation on walls, piping, and equipment in wet wells when ozone is admitted to the atmosphere. This plus value to odor destruction has been observed at Florida installations of Invex Ozonators in sewage pumping stations. Although, to date there is no accurate scientific explanation of this drying effect, it has been observed in many installations using ozonators. This effect from ozonation understandingly appeals to plant operators.

According to the company, all Invex basic designs have been subjected to severe tests in the laboratory; breakdown, voltage overload, underload, current interrupter, spark tests, arc tests, and total destruction. The units have also been field tested under adverse conditions, such as in moisture-laden atmospheres of outlying, underground pumping stations.

Rate Yourself as a

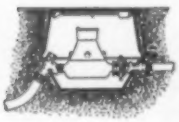
METERologist...

CHECK HERE

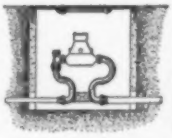
- ☐ Do you believe in setting water meters so that they are most available for quick and easy reading?
- ☐ Do you provide installations which put meters in the proper position and protect them from dirt and damage?
- ☐ Are your meters connected into the line so that changing can be quick and trouble-free?
- ☐ Do you test meters periodically and maintain them for maximum accuracy?

If you have checked all four you probably use Ford equipment. Don't be discouraged if your grade is off a little; the easy first step toward improving it is to send for a FORD CATALOG. IT'S FREE.

These Ford Products Make it Easy for you to be a METERologist

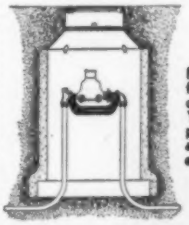


YOKE BOX
For shallow services the Yokebox provides protection to keep meter clean, easy to read and easy to change.



COPPERSETTER
A complete meter mounting that brings the meter up for easy reading and changing. Holds service line permanently connected.

COPPERHORN
Ideal setting for most basements with vertical service lines. Often saves more than its cost in pipe fittings.



DOUBLE LID SETTING
Provides maximum frost protection in cold climates. The Yoke holds risers permanently braced and connected for easy meter changing.

FORD FOR BETTER WATER SERVICES

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

Heat Resistant Paints
911

Chem Industrial Co., Brooklyn, Ohio, has announced the addition of 3 new colors to its line of C-I "Extra High" heat resistant paints.

Formerly offered only in aluminum, it is now available in gold, metallic red and metallic blue. All 4 shades are said to resist temperatures up to 1700°F without flaking, blistering or burning.

Each C-I "Extra High" coating is composed of a clear silicone base with a special metallic pigment. This combination air dries to a bright finish in approximately 30 minutes. Then, when heated, it is reputed to virtually fuse with the surface upon which it is applied.

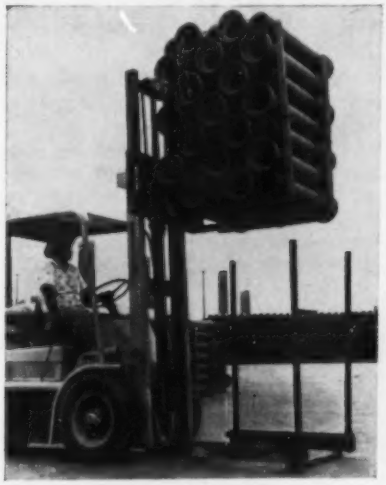
According to the manufacturer, "Extra High" forms a metal coating that resists moisture, corrision, mild acids, alkalis and industrial fumes. It can be applied by either brush or spray gun.

Palletized Clay Pipe Reduces Costs—Breakage
912

Gladding, McBean & Co., Los Angeles, Calif., has effected a practical solution to the handling, shipping and storage problem for clay pipe.

The system, which combines pallets and handling by fork lift

trucks, enables pipe up to 8 inches in diameter to be stacked end for end on a steel jiggering frame by



means of a fork lift truck equipped with a special pipe handling attachment that permits 4 to 8 pieces of pipe to be moved at one time. After the pipe has been stacked in the frame a no charge, expendable wooden pallet type backing is banded around the pipe and the unit load is transported to the storage area by a fork lift truck. Under the old system, loading an average truck with clay pipe required sixteen manhours, now the same job requires the equivalent of three manhours in personnel and equipment time.

Railroad and trucking officials have noticed that this system of pipe handling has reduced in-transit breakage by an average of 75%. Because it permits moving pipe in unit loads, this system has effectively reduced handling costs all the way from the plant to the job.

Redesigned Ring Balance Meter

913

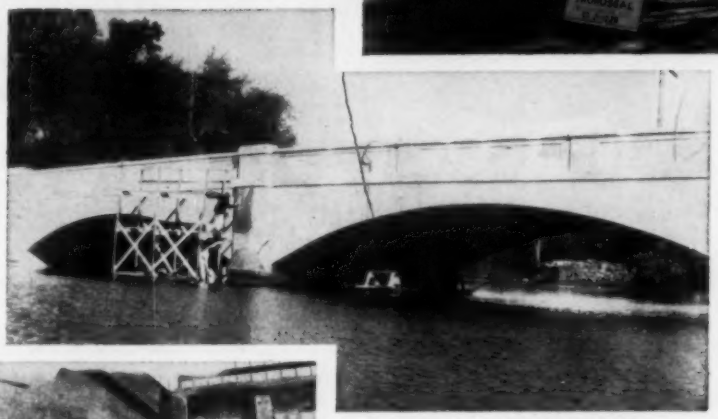
Hagan Chemicals & Controls, Inc., Pittsburgh, Pa., has redesigned the Hagan Ring Balance Meter to incorporate many new engineering features.

These new features include: (1) Fully enclosed measuring system in which no working parts contact the measured fluid, (2) Stuffing boxes and pressure tight bearings are eliminated, (3) Quality and density of sealing fluid is not critical, (4) Complete series of measuring elements for full scale range from 0.5 in. WC at 5 psig to

(*Continued on page* 128*A*)

It's New Again with THORITE and THOROSEAL

Freeze-thaw cycle following water and moisture penetration, also swelling of reinforcing rods from moisture contact, cause masonry destruction.



BRIDGE OVER CONCORD RIVER
ROUTE 3, BELLERICA, MASS.

Workmen on scaffold patch spalled and cracked concrete with THORITE and seal surface with THOROSEAL.

Area at left chipped to sound masonry. It will then be patched with THORITE *Nonshrink, Nonslump 20-Minute Set Patching Mortar*, without necessity of costly forming, finished by application of Thoroseal.

Request Circular No. 16 and 20.

Write for our 16 page "How to Do It"

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNSYLVANIA • CENTERVILLE, INDIANA

WANT MORE SPARKLE?

Let N-Sol activated silica (coagulant aid) help you to improve water quality. Highly colored or turbid waters sparkle like spring water with N-Sol. Its large, heavy, rapid-settling floc enmeshes more impurities.

Write for copy . . . **"Jar Test Procedure for Activated Silica Sol".**

PQ SOLUBLE SILICATES

N-Sol conveniently made in your plant from "N" sodium silicate and a reacting chemical.

PHILADELPHIA QUARTZ CO.
1166 Public Ledger Bldg., Philadelphia 6, Pa.

Trademarks Reg. U.S. Pat. Off.

GUNITE does it **2** times as fast at **1/2** the cost

"Gunite" is the modern process (sand and cement applied pneumatically) for repairing, constructing, lining:

- Reservoirs
- Dams
- Filter Plants
- Sewage Disposal Plants
- Tanks
- Stadiums
- Bridges
- Sea Walls
- Swimming Pools, etc.

Write FOR MORE INFORMATION, INCLUDING 48 PAGE "GUNITE" BOOKLET.

PRESSURE Concrete Co.

FLORENCE, ALA. 315 So. Court Street

OTHER OFFICES IN

CHARLOTTE, N. C. Liberty Life Bldg.
CHICAGO, ILL. 33 N. LaSalle Street
NEWARK 5, N. J. 193 Emmet Street

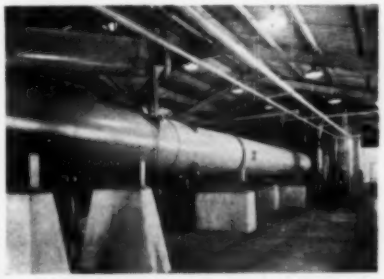
560 in. WC at 6,000 psig, or 140 in. WC at 15,000 psig, are available, (5) Dead weight checking without disconnecting the meter piping, either at atmospheric or full static pressure, (6) Ring torque at minimum full scale differential is ten times the power required.

Easy accessibility is built into each instrument through the use of a sectionalized case. A swinging front and a four-piece back permit complete checking and recalibration without disconnecting the meter or removing it from its mounting. Test weights are used for checking instead of unwieldy manometers.

Rotary Dryers For Sewage Sludge

914

Standard Steel Corporation, Los Angeles, Calif., and Decatur, Illinois has developed a new drying system for treatment of sewage sludge and industrial wastes. Basic unit in the system is the Standard-Hersey rotary dryer which can handle sludge of 75 percent—80 percent moisture, reducing it to 6 percent moisture.



According to the manufacturer the equipment is compact, the original investment is lower by nearly one half compared with older style dryers, the system can come on-stream quickly and be shut down smoothly, and it represents an all-weather operation. Another advantage is the savings in space for the installation.

A saleable product of uniform particle size, friable and non-dusty in character, is obtained. This product can be treated to a definite pH (by adding ferrous sulphate to lower pH or lime to raise it) and can be improved as a fertilizer by easy addition of nitrogen and phosphorous. The process lends itself to simple addition of chemicals. The dryer serves as an excellent mixer and the sludge is a good carrier of additives because of its bulky nature.

W&SW MANUFACTURERS NEWS

B-I-F Appoints Soscia Project Engineer

Builders-Providence, Inc., Division of B-I-F Industries, Inc., Providence, R. I., has announced that Bamby L. Soscia was recently appointed a project engineer for Synchro-Scan Control and Telemetering equipment.

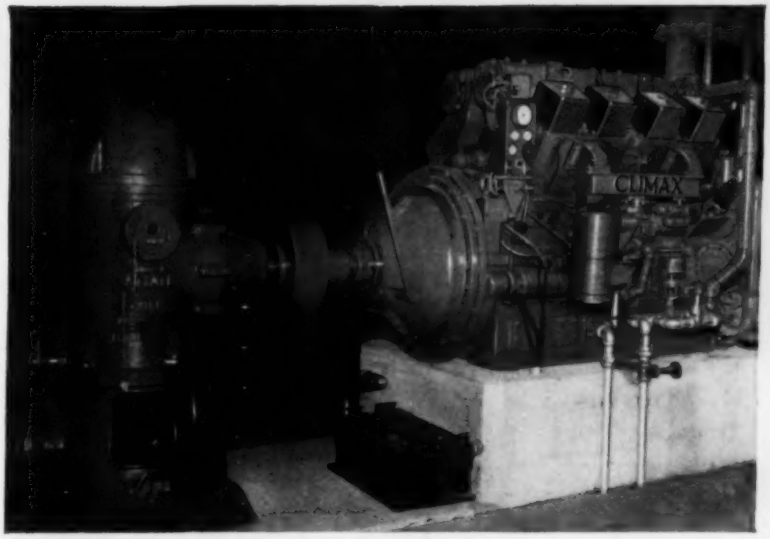
Mr. Soscia received his BSEE degree from the University of Rhode Island. His electrical engineering experience has included the design, project, and development phases for major manufacturers of electronic components.

Pitometer Associates Promotes Five

The Pitometer Associates, New York, N.Y., has announced that E. D. Case, who has been President since 1946 will become Chairman of the Board of Directors, E. Shaw Cole who has been Vice President and Chief Engineer will become President, and H. E. Beckwith will become Vice President to succeed Mr. Cole. Mr. C. R. Bird will remain as Vice President in charge of the Chicago office. The new position of Principal Engineer will be initiated and this office will be filled jointly by W. D. Hudson presently Assistant Chief Engineer in charge of the Atlanta office and by Mr. J. M. Shanley now in charge of the Houston office.

Mr. Case who was graduated from Princeton in 1908 entered the employ of the Company in 1910 and rejoined it in 1914 after an absence of three years with the New York City Water Department. He will continue actively with the Company in his new position as Chairman of the Board.

(*Continued on page* 130*A*)



IMPORTANT FACTS ABOUT CLIMAX STANDBY ENGINES!!

CHOICE OF FUELS—
All models operate with equal efficiency on gas, butane or gasoline.

FAST, EASY STARTING—
Climax engines take over the complete load within seconds after normal utility power fails. If the starting system is manual, you merely press a button on the instrument panel...if automatic, the engine starts immediately.

SIMPLE TO OPERATE—
All instruments and controls are located at the sides of the engines . . . easy to read . . . easy to adjust.

SIMPLE TO MAINTAIN—
Accessories are within "arm's reach" to allow quick inspection and adjustment. Crankcases and engine bases have large hand holes on each side for easy access to all working parts.

SAFETY PROTECTED—
Safety devices are standard equipment on all models and automatically protect the engines against high water temperature and low oil pressure. An overspeed governor can also be furnished, if required.

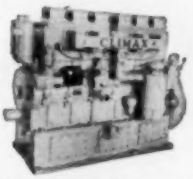
ACCESSORIES—
Various types of cooling and starting systems, mufflers, etc. are available to make each engine suitable for a particular application.

LONG ENGINE LIFE—
Climax engines are constructed of the finest metals, alloys and component parts available. Any model will give years of service if properly maintained.

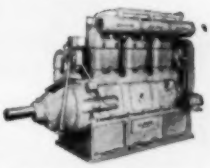
Write today for complete information, bulletins or engineering consultation

V-125—12 cylinder, 605 max. H.P. at 1200 R.P.M.
V-122—12 cylinder, 520 max. H.P. at 1200 R.P.M.

V-85—8 cylinder, 390 max. H.P. at 1200 R.P.M.
V-80—8 cylinder, 340 max. H.P. at 1200 R.P.M.

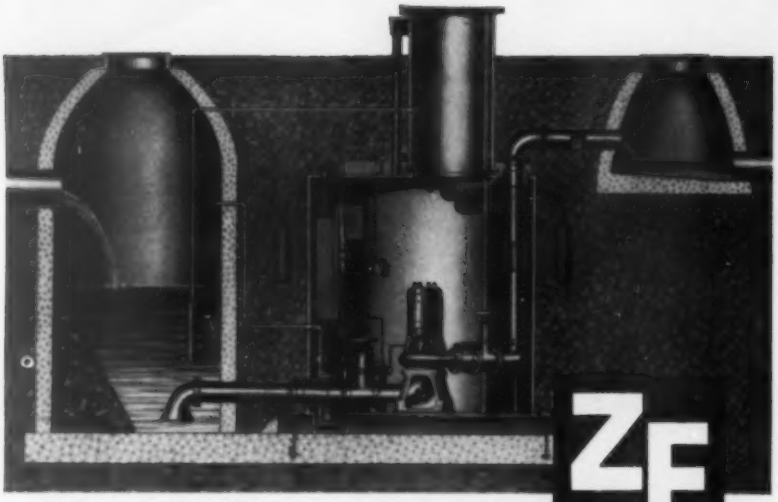


K-75—6 cylinder, 302 max. H.P. at 1200 R.P.M.
K-67—6 cylinder, 265 max. H.P. at 1200 R.P.M.



R-165—6 cylinder, 192 max. H.P. at 1200 R.P.M.
R-110—4 cylinder, 130 max. H.P. at 1200 R.P.M.

CLIMAX ENGINE MANUFACTURING CO.
208A South LaSalle Street • Chicago 4, Illinois
Factory—CLINTON, IOWA • *District Office*—DALLAS, TEXAS
In Canada—Canadian Fairbanks-Morse Co., Ltd., Montreal and 16 Branches



Z-F

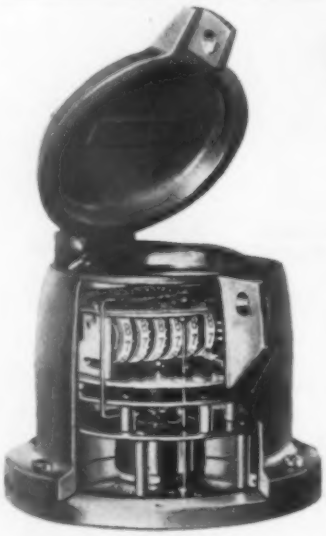
Before engineering your sewerage system consider the advantages of this...

PREFABRICATED PUMPING STATION

- Installation can be made with a minimum of time and cost.
- Can be installed on existing public property.
- Entire unit is prefabricated and shop-fitted with standard, well-known equipment.
- Usually can be located at most advantageous spot for existing gradients.
- It is feasible to move and relocate should conditions change.
- Improved equipment, controls and prefabricating technique make the Z-F Station an economical and reliable unit. Write for details.

(Territories open for representatives)

Manufactured by ZIMMER & FRANCESCON, Moline, Illinois



SPARLING

Presents a Completely New Rate of Flow

INDICATOR-TOTALIZER

the **245**

Sparling is pleased to present its new *245* tachometer type Indicator-Totalizer—built especially for *Main-line duty*. The *245* is the result of 8 years of research and development work in Sparling's laboratory.

Its virtues? It is precise in measurement and it is built for the *rugged, long life required on the Main-lines*. Heavy duty, corrosion resistant materials are the guarantee of this statement!

★ READ IT QUICKLY
★ LOW COST MAINTENANCE
★ PRECISE ACCURACY
★ LEAK PROOF STUFFING BOX

OTHER OFFICES:
Atlanta Chicago Cincinnati
Dallas Kansas City, Mo.
Los Angeles Roselle, N. J. Seattle
San Francisco Toronto, Can.
Romford, England

Sirs: Please send us more information on Sparling's new 245 Indicator-Totalizer

Name .....

Company .....

Address .....

City ..... Zone..... State.....

Send to: Dept. WSW-9
Sparling Meter Co.
2225 North Temple City Blvd.
El Monte, California

Mr. Cole, who is the son of Edward S. Cole the founder of the Company, obtained an A.B. degree from Dartmouth in 1930 and a C. E. degree in 1931. After working for his father and the Pitometer Log Corporation on hydraulic investigations and tests, he joined the Pitometer Associates as field engineer in 1934. In 1939 he received a Master's Degree in C. E. from New York University and then worked for the consulting engineering firm of Newsom and Aldrich. He rejoined the Pitometer Associates in 1940 as Chief Engineer.

Mr. Beckwith was graduated from Syracuse University in 1915 and has been with the Company since 1921.

Haskett Named Manager of F & P Water & Wastes Div.

Fischer & Porter Company, Hatboro, Pa., has announced the appointment of James F. Haskett as General Manager of the Water & Waste Division. Mr. Haskett replaces Robert L. Rice who becomes General Sales Manager, coordinating the sales efforts of all four divisions of Fischer & Porter.

Mr. Haskett, a graduate of Northwestern Technological Institute, has been with Fischer & Porter for the past seven years. His professional affiliations include membership in the American Water Works Association and the Federation of Sewage and Industrial Wastes Association.

Permutit—Pfaudler To Merge

The Boards of Directors of the Pfaudler Co., Rochester, New York, and The Permutit Company, New York City, have approved submitting to stockholders a proposal to merge the two companies under the name of Pfaudler Permutit, Inc. Previously Pfaudler had purchased approximately 25% of the outstanding shares of the stock of Permutit from Ward Industries Corporation.

Joining the companies would

bring together the originator and world's largest manufacturer of industrial glassed steel processing equipment and the pioneer and largest producer of water conditioning equipment and ion exchangers and power plant accessories. It would open the way for major participation in the huge market for pollution control and industrial treatment of waste water, as well as greater diversification in the products of both companies.

Henry W. Foulds, Chairman of the Board and President of Permutit and Raulet Miner, Board Chairman of Pfaudler would become Chairman and Vice-Chairman respectively of the Board of the combined companies. Mercer Brugler, President of Pfaudler, would be President and Chief Executive Officer and Donald A. Gaudion, Pfaudler Executive Vice-President, would be Executive Vice-President of the merged firms. No other changes are contemplated in the immediate future.

Cochrane Joins Neptune Meter

Neptune Meter Company, New York, N. Y., has announced that Mr. William H. Cochrane has been elected a director and has joined the management staff of the company as Executive Vice President.

Mr. Cochrane fills a newly created office which has been established to provide closer coordination among the parent organization and its many subsidiary companies.

Prior to joining Neptune, Mr. Cochrane was associated with Lever Brothers Company, as General Manager of the industrial division.

Clay City Pipe Rebuilding Sewer Pipe Plant

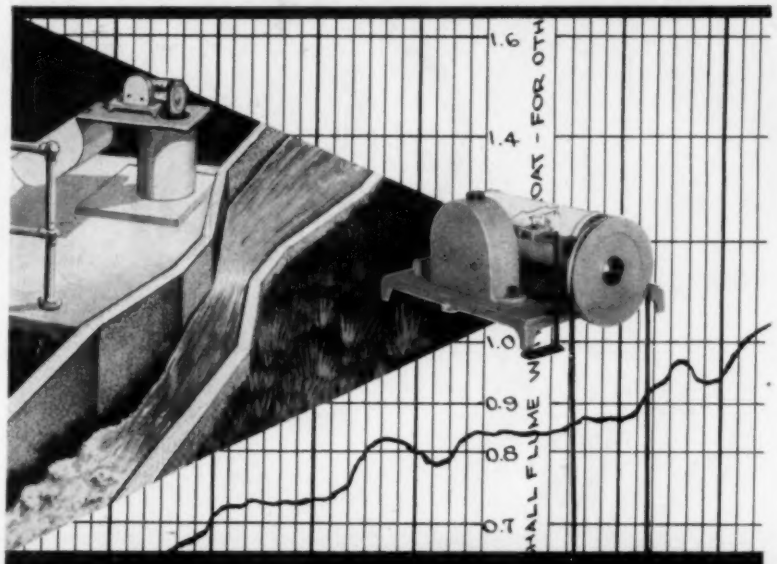
The Clay City Pipe Co., Uhrichsville, Ohio, has announced the rebuilding of the company's sewer pipe plant at a cost of more than $1,000,000.

Designed to house the latest and best clay pipe manufacturing equipment, 16 masonry drying compartments, a 300-foot tunnel kiln and storage bins, with 123,000 sq. ft. under roof, the new building replaces a 32-year old structure destroyed in a $500,000 fire.

The new equipment will be used in the manufacturing of pipe in lengths up to five feet and in diam-

(*Continued on page* 133A)

NOW Low-Cost Automatic Flow Recording



STEVENS Type F Recorder

For Measuring Sewage, Industrial Waste and Other Flows

Flow charts directly readable in million gallons per day or gallons per minute over various sizes of Parshall flumes. The same recorder can also be used with charts reading in feet and hundredths to record head or surface fluctuations in lakes, streams and wells. Priced from $132. Write for free Bulletin 24.

The planning and efficient operation of any project which involves measurement of flowing liquids is based on flow data which can be obtained with STEVENS Water Level Recorders. STEVENS instruments are at work compiling data on hydro-electric and flood control projects and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

Experienced technical staff available for consultation on any liquid measurement installation. Write, giving description of project, and scope of data desired.

●

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N. E. Glisan Street
Portland 13, Oregon

●

Specialists in Hydrologic Instruments for Half a Century

STEVENS DATA BOOK

invaluable for your reference file

144 pages of technical data on recorder installations, plus a wealth of hydraulic tables and conversion tables. $1.00 each. (No COD's.)

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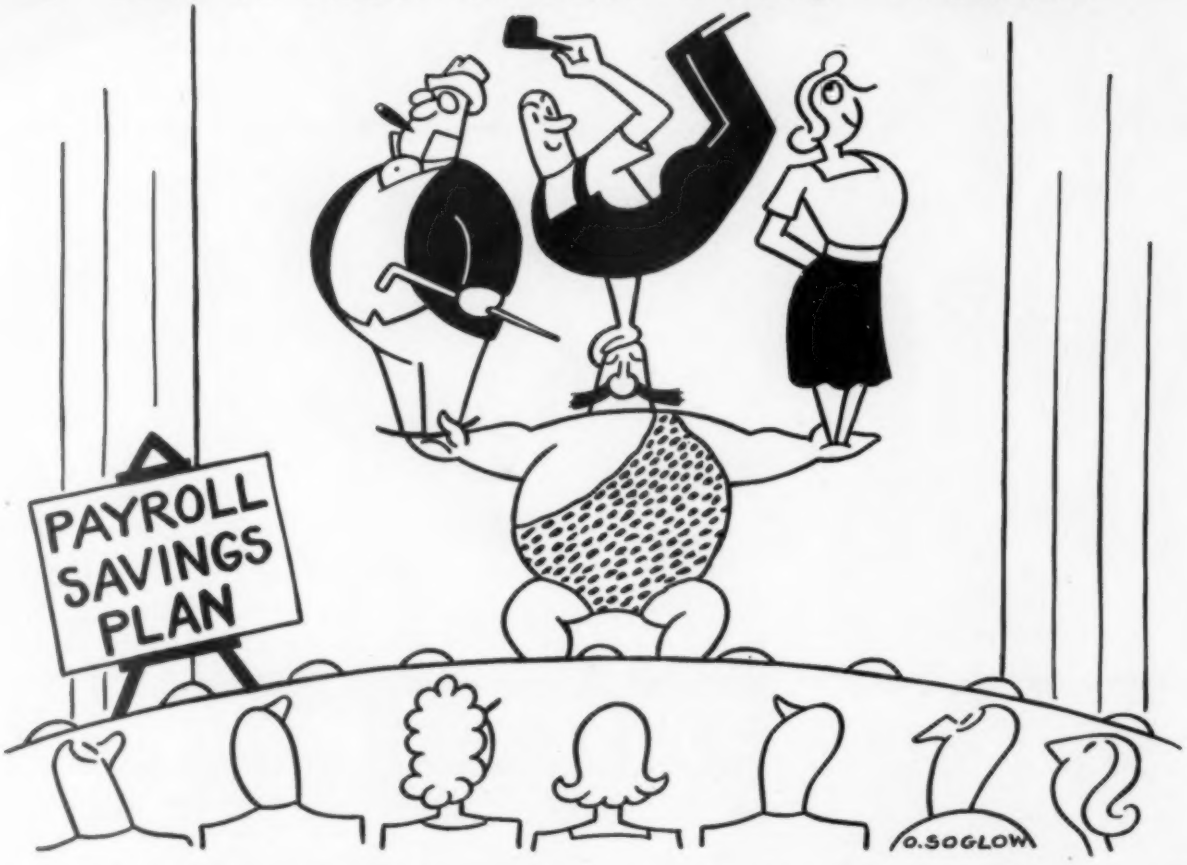
Please rush _____ copies of the STEVENS DATA BOOK for which I enclose $1.00 each.

Name _____

Address _____

"Got A Load On Your Mind? I Haven't"



Nothing gives employees a more luxurious, satisfied feeling than that of financial security. And nothing is easier for them to achieve when you provide the convenience of automatic Payroll Savings Plan.

EVERYBODY BENEFITS

Security breeds confidence—and confidence stimulates job interest and results in steadier people who are far more efficient in their work. Receiving those crisp Bonds at regular intervals along with their paycheck is an added inducement for employees to stay on the job.

Moreover, when you install the Payroll Savings Plan in your company, you promote not only the security of your personnel but the security of your company and your country. Over forty million Americans have over 40 billion dollars invested in United States Savings Bonds—a backlog of purchasing power for the future.

EASY TO INSTALL

If your company does not now have a Payroll Savings Plan, or if employee participation is less than 50%, a letter to: Savings Bonds Division, U.S. Treasury Department, Washington, D. C. will bring prompt assistance from your State Director. He will provide application cards, promotional material, and as much personal help as you need.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

WATER & SEWAGE WORKS

eters of 3 to 30 in. Wedge-Lock clay pipe and die-cast bituminous jointed pipe will be added to the company's line.

Fischer & Porter Mobile Exhibit To Tour U.S.

Fischer & Porter Company, Hatboro, Pa., has announced that it is sending a mobile exhibit of its products on a swing around the country.

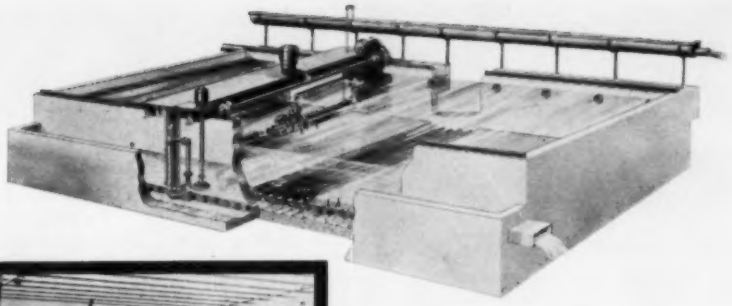
The exhibit is housed in a specially constructed stainless steel trailer, completely equipped to give on-the-spot operating demonstrations of many F&P products before customer groups, technical schools and universities and at meetings of engineering societies.

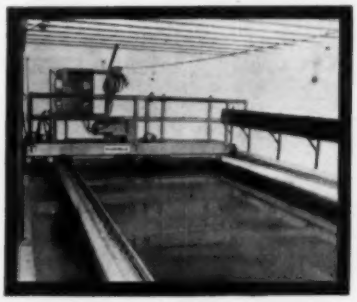
The exhibit is expected to reach the northwestern coast in late October. Turning southward, the trailed will tour California, then make its eastward by a southern route. Arrival at Fischer & Porter's home office is planned for June 1958.

Hydraulic Development Co. Now Manufacturing Hydro-Tite in Spain

Hydraulic Development Corporation, New York, N.Y., has announced that the company's European Company, HydroTite, S.A., Calle Mayor 18, Madrid, Spain, has now started the manufacture and distribution of Hydro-Tite throughout Europe.

The accompanying photograph showing the plant (above) as it neared completion, was taken last fall by Mr. R. F. "Reg" Hayes, Vice President, while in Spain setting up the operations for Hydro-Tite S. A.





12½′ x 40′ Hardinge Automatic Backwash Sand Filter in a municipal water plant in Vermont.

12½′ x 86′ Hardinge Filter handling water supply for a Canadian paper plant.

A sand filter which

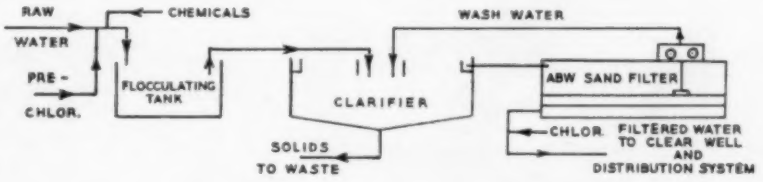
CLEANS ITSELF

The Hardinge Automatic Backwash Sand Filter is a complete departure from standard filtration equipment, in that it backwashes its filter bed automatically without interrupting normal filtration.

The ABW filter in combination with flocculation and sedimentation equipment provides treated and filtered water for municipal and industrial water supplies.

The filter may be applied also for the treating of plant waste water, for reuse or disposal.

Complete specifications upon request. Bulletin 35-D-15.



The flow sheet above illustrates the use of a Hardinge ABW Filter, in conjunction with Hardinge flocculating and clarifying equipment, on municipal or industrial water treatment. A modified system is available for liquid waste disposal or reclamation.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA · 240 Arch St. · Main Office and Works

New York · Toronto · Chicago · Hibbing · Houston · Salt Lake City · San Francisco

Could this have been pumped by anything but a LIQUID IMPELLER?

It was dented, and somewhat the worse for wear, but nevertheless still recognizable as an auto muffler. The question: how did it get into the re-pulp stock line from the hydropulper?

The answer is simple. The muffler, twelve inches long, was *pumped* out of the hydropulper through an *eight*-inch Wemco torque-flow Solids Pump.

This is an actual case history, typical of many about this amazing pump and its "can't clog" *liquid impeller* action. Interested? Just ask for the facts.

WEMCO

TORQUE-FLOW

SOLIDS PUMP

WESTERN MACHINERY COMPANY

650 FIFTH STREET, SAN FRANCISCO 7, CALIF.

W&SW

New Literature

Coagulant Aids

915

Hagan Chemicals & Controls, Inc., Pittsburgh, Pa., has just issued a new four-page bulletin describing **Hagan Coagulant Aids** for use in municipal and industrial water clarification, and waste water treatment systems.

The booklet points out that these aids speed up floc formation and also tend to produce larger, heavier, tougher flocs over wider pH ranges than coagulants alone.

Reporting on extensive field tests during the past two years the booklet shows that the addition of coagulant aids to clarifiers has materially increased capacities while reducing the amount of coagulant feeds required.

Included in the two-color bulletin are case histories describing how various water clarification processes were substantially improved by introducing Hagan aids into the system.

Floating Roof Catalog

916

Hammond Iron Works, New York, N. Y., has just released a 24-page illustrated catalog on **Floating Roof Tanks.**

The catalog describes in detail various types of floating roof tanks used for storing all types of volatile or corrosive products. Construction features and functional advantages of each type are clearly discussed and illustrated.

Two types of patented Hammond floating roof seals are also described in the catalog, the Springtite seal and the Hammond Tubeseal. Construction details for both types of seals are fully described and illustrated. Details are also presented in the catalog for converting existing floating roofs to Tubeseals. The Tubeseal can be adapted to any tank, regardless of size and whether riveted or welded.

An additional interesting and informative section of the catalog consists of a series of questions and answers on the construction and application of the Tubeseal. The questions are those which have been most frequently asked over the past few years by users and potential users of the Tubeseal.

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High Accuracy Dry Feeder

917

Omega Machine Co., a division of B-I-F Industries, Inc., Providence, R. I., has just published an 8-page, colored bulletin describing the simple, rugged construction of the **Omega Universal Feeder,** designed to feed any dry material dependably and accurately over a 40 to 1 adjustable feed rate.

Informative sections describe the various models, design features, principles of operation, and show allied accessories available. Capacities and dimensional data are included, and illustrations show cutaway views, halftone illustrations, and typical installation photographs.

Chemical Resistant Tank Lining

918

Dow Chemical Company, Midland, Mich., has just published an 18-page illustrated booklet on **Saraloy 898, Chemical Resistant Sheet.,**

The booklet gives detailed information on this flexible thermoplastic, chemical-resistant lining for storage tanks, processing tanks. medium to large diameter pipes and fittings, fume ducts and hoods.

The information includes data concerning its properties, the materials, equipment and procedure for installation, care and repair of linings and storage of the sheet. The sections on preparation of the tank for lining, application of the sheet and the procedure for making joints are especially explicit. Detailed drawings illustrate the material.

Brass Composition Valves

919

Crane Co., Chicago, Ill., has just published a new folder on **Brass Composition-Disc Globe, Mangle,** and **Life Check Valves.**

The folder emphasizes the advantages of the composition disc brass valve for a broad range of services, including steam, water, air, oil, gas and gasoline. It shows in pictures the ease with which Crane's quick-change composition disc may be replaced without removing the valve body from the line.

The new folder also shows other major design features of Crane brass composition-disc valve lines, and gives complete sizes and dimensions.

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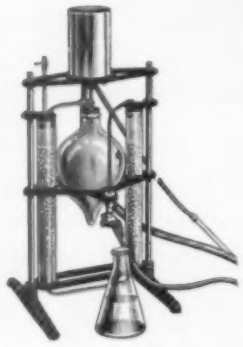

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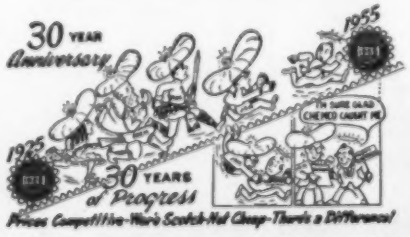

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"EVERYTHING FOR THE SWIMMING POOL"

Motor-Driven Controlled Volume Pumps

920

The Milton Roy Company, Philadelphia, Pa., has recently published a bulletin describing their complete line of **Motor-Driven Controlled Volume Pumps.**

This 32-page bulletin contains complete specifications and latest design features of these positive displacement pumps, designed for precise metering and pumping of corrosive liquids against pressure. According to the bulletin, these pumps have wide industrial usage as final control elements in proportioning and control systems for blending, formulating and chemical feeding. Other uses include metering and control of pH, Redox, conductivity, flow, liquid level, temperature, pressure or other measured variables.

Standard and modified models and their applications are illustrated and described in this bulletin. A special feature section contains useful data and charts with recommendations for materials selection and usage plus other handy reference information.

Automatic Self-Cleaning Grease Interceptor

921

The J. A. Zurn Mfg. Div. of Zurn Industries, Inc., Erie, Pa., has announced publication of a 4-page descriptive catalog covering the **Enzymatic Greaseptor,** the new self-cleaning, automatic grease interceptor which ends the untidy chore of grease trap cleaning.

The catalog describes a new approach to grease interceptor cleaning—the use of enzyme concentrates that convert accumulated grease by biochemical reaction into water-soluble compounds that automatically flush away into the drainage system. The catalog provides details as to how the Enzymatic system operates, as well as dimensional, construction and installation data.

Asbestos-Cement Sewer Pipe And Fluid-Tite Couplings

922

Keasbey & Mattison Co., Ambler, Pa., has just published a new 8-page brochure on **K & M Asbestos-Cement Sewer Pipe and the Exclusive Fluid-Tite Coupling.**

In addition to listing the various

sizes and types of asbestos-cement sewer pipe and connections available, this brochure also describes features of the pipe and its infiltration-proof Fluid-Tite coupling. This exclusive coupling which has successfully withstood an external water-pressure test of 25 psi, is assembled quickly and easily, absorbs vibration, keeps out roots, and allows five degrees deflection at each joint.

Swimming Pool Pumps

923

Marlow Pumps Div., Bell and Gossett Co., Midland Park, N. J., has available a new **Swimming Pool Pump** bulletin.

This bulletin contains information on the complete line of Marlow swimming pool pumps. These pumps are designed specifically for swimming pool applications and are easily adapted to all types of pool filtering and vacuum cleaning systems both private and commercial.

Bronze Gate Valves

924

Ohio Brass Company, Mansfield, Ohio, has available a handy new folder that makes the selection of the right **O-B Bronze Gate Valve** easy.

The valves are clearly charted by number, pressure rating, size, type of pipe end, and stem design. In addition, the folder describes the basic characteristics to be considered in selecting gate valves and tells when these valves should be used.

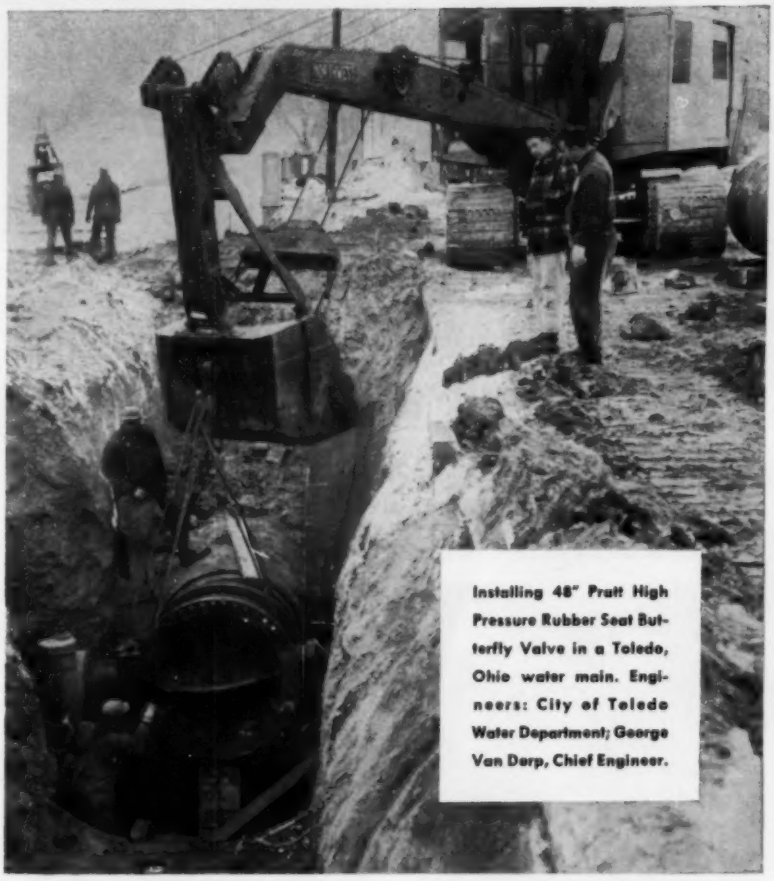
Automatic Engine Stop Valve

925

Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has just published an 8-page bulletin that fully describes the **G-A Cushioned Automatic Engine Stop Valve.**

According to the bulletin, the G-A combined throttle and automatic engine stop valve is used to automatically shut down the turbine compressor, or engine in the event of overspeed or runaway.

Featured in this new technical bulletin are typical installation diagrams, various tripping mechanisms, sequence of operation, parts list, dimensions, and specifications.



Installing 48" Pratt High Pressure Rubber Seat Butterfly Valve in a Toledo, Ohio water main. Engineers: City of Toledo Water Department; George Van Derp, Chief Engineer.

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Long after this valve is buried, in six months or sixty years, it will still be **easily opened or closed by one man using a standard tee-wrench.** The design features of Pratt Valves are aimed at the kind of honest dependability you need for water main use... the disc edge is corrosion-resistant and seats accurately in a rubber liner made extra-heavy to prevent permanent set. The one-piece stainless steel valve shaft rotates in lifetime lubricated bronze bearings, and the operator is permanently lubricated and sealed to withstand seepage.

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Pratt engineers stand ready to help you select valves for distribution service or any water works application. Call on them with your next valving problem.

Have you sent for your copy?...of Pratt's 40 page Manual of Rubber Seat Butterfly Valves. Useful—contains latest pressure drop and flow data, conversion tables, butterfly valve theory and application. **Bulletin B-2B.**

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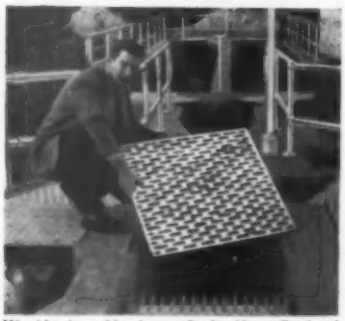
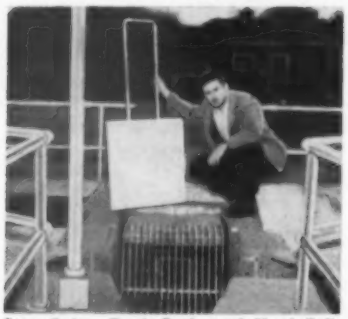
Above: Settling basins and drying beds of the modern new Sewage Treatment Plant at Clinton, Mass., showing maintenance-free aluminum railings and walkways constructed by Washington Aluminum Co.

WAC © T.M. Reg. Canada Fabricated Aluminum Equipment Serves Mass. Sewage Treatment Plant



Washington Aluminum Co.'s New England Representative, points out patented perforation pattern in WASHINGTON ALUMINUM CO.'s fabricated walkway.



Stop Gates, Trash Racks and Hand Railings of non-corrosive aluminum, specially fabricated by WASHINGTON ALUMINUM CO. for trouble-free service.

Aluminum Checkplate Manhole Cover. Note the Aluminum Ladder.

The Clinton, Mass., Sewage Treatment Plant is typical of an aluminum installation fabricated by Washington Aluminum Co. for use where long-range durability, sanitation and maintenance-free service are desired. The aluminum walkways, gratings, hand-railings, manhole covers, ladder rungs, stop gates, trash racks and stairways of the Clinton Plant illustrate Washington Aluminum Co.'s precision fabrication and quality control to meet the most exact specifications.

Today, an increasing number of water and sewage installations are benefitting through Washington Aluminum Co.'s experience and specialization in aluminum fabrication—including exclusive Heli-Arc and Sigma welding techniques.

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Safe Handling For Sulphuric Acid

926

Proportioneers, Inc., a division of B-I-F Industries, Inc., Providence, R. I., has just published a bulletin describing the automatic and/or continuous **Dispensing of Acids** without subjecting the operator either to contact with the acid or exposure to its fumes.

According to the bulletin, this low cost, safety equipment was designed to avoid costly lost time accidents and safeguard those involved in handling this hazardous chemical. The bulletin also tells how this new acid dispenser insures more uniform results and greatly reduces processing time and costs. Also described in the operation, the materials of construction, and illustrations are provided showing the various models available which handle capacities from 8 to 24 GPH.

Darling Valve Catalog

927

Darling Valve & Manufacturing Co., Williamsport, Pa., has just published a complete new 244-page catalog covering **Darling Valves.**

The catalog covers gate valves, check valves and fire hydrants in a broad range of types, sizes and constructions.

The new catalog, well illustrated and diagrammed, goes even further than the previous catalog in the simplified presentation of useful data and referencing information.

In addition to adequately covering the company's latest developments, such as the Darling-McEvoy Automatic self sealing conduit gate valves, ball-bearings-operated dry-top hydrants and special purpose corrosion resistant valves, the new catalog includes extensive engineering data, application tips, valve accessories information and reference data on materials, specifications and standards.

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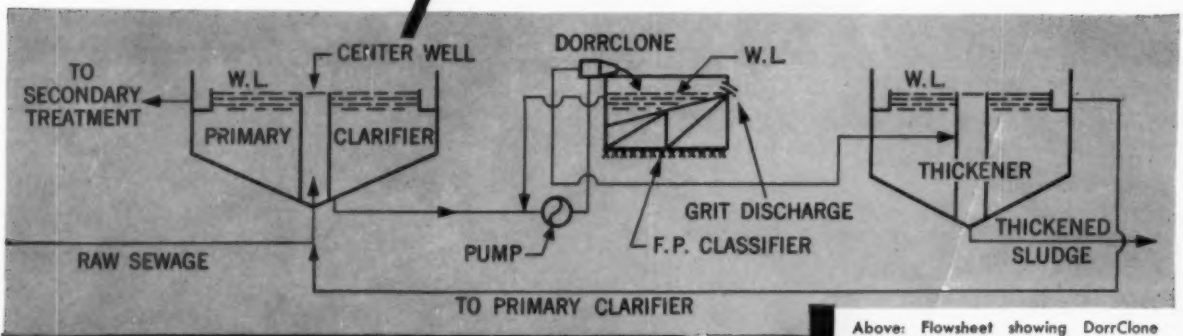

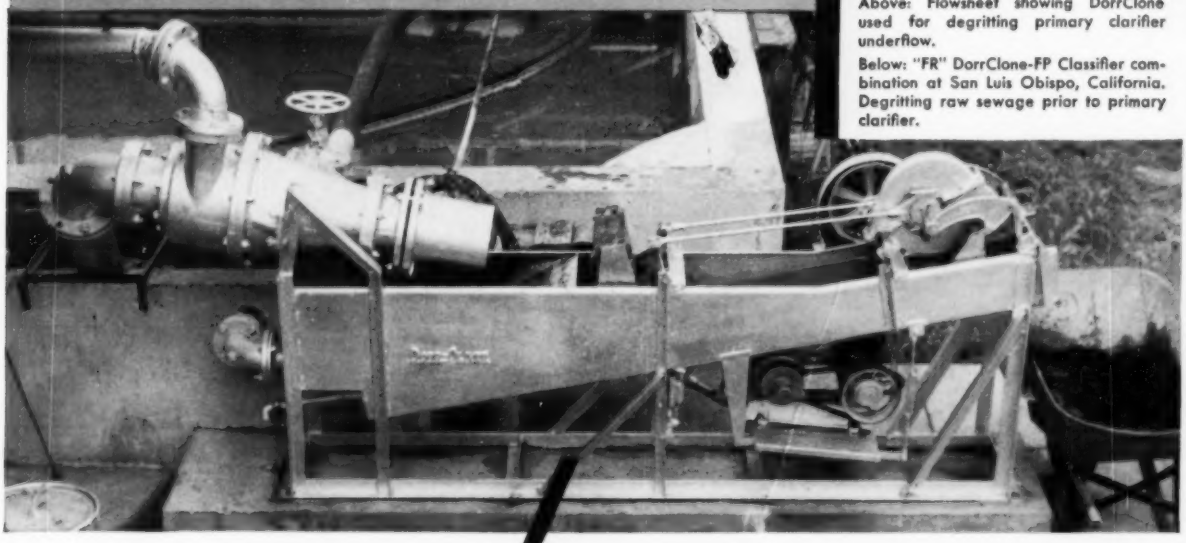

Above: Flowsheet showing DorrClone used for degritting primary clarifier underflow.

Below: "FR" DorrClone-FP Classifier combination at San Luis Obispo, California. Degritting raw sewage prior to primary clarifier.

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for degritting sewage

Proven for many years in a wide range of industrial and chemical processing applications, the DorrClone Classifier has now been adapted to the sewage treatment field for removing grit from raw sewage and settled sludge.

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Full scale installations have proven that this unit is applicable to the degritting of raw sewage prior to primary sedimentation; the degritting of primary clarifier underflow prior to Densludge Thickening; and the washing of Detritor Collecting Tank discharge.

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